The Arte of Nauigation,

Conteyning a compendious description of the Sphere, with the making of certayne Instrumentes and Rules for Nauigations, and exemplified by many Demonstrations. Written by Martin Curtes, Spaniarde. Englished out of Spanyshe by Richarde Eden, and now newly corrected and amended in diuers places.

1579.

VVherevnto may be added at the wyl of the byer, another very fruitefull and necessary booke of Nauigation, translated out of Latine by the sayde Eden.

And Prynted by Richard Iugge.

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To the ryght woorshipfull Syr Wylliam Garerd Knyght, and Maiſter Thomas Lodge, Aldermen of the Citie of London, and Gouernours of the honourable Felowſhyp or Societie, as well of *certayne of the Nobilitie, as of Merchantes Aduenturers*, for the diſcouery of Landes, Territories, Ilandes, and Seignories vnknowen, and not before their firſt aduenture or enterpriſe by Seas or Nauigations commonly frequented.

And to the ryght woorſhypfull the Conſulles, Aſſyſtentes, and Comminaltie of the ſame Societie, Richard Eden wyſheth health and proſperitie.

WHAT ſo euer he was (ryght honorable and woorſhypful) that firſt beleued that the frame & coaptatiõ of the body of man, with the functions, offices, and dueties of the partes and members of the ſame, knyt togeather in a certayne vnitie to a common miniſtration, dyd repreſent a lyuely image and ſimilitude of a perfect common wealth: I thynke that he was a man of no vulgar iudgement, or abiecte mynde, but rather of ſinguler wyſedome and prudence, in the contemplation of diuine and humane thynges. For he ſawe, that as in the ſmal natiue ſeede of al growyng or lyuing thynges, is conteyned the fourme that bryngeth them to their perfection: ſo in certayne ſmall and obſcure members of the common wealth, conſyſteth no ſmall encreaſe to the perfection of the whole. He ſaw lykewyſe, that herein, as in the body of man, repreſentyng the partes and members of the worlde (as I haue ſayde) are diuers partes of diuers and ſundry actions and motions, greatly differyng in fourme, number, and quantitie, yet al the ſame to be ſo knyt togeather,

and so to consent in one vniformitie, to the common profite of the whole, that a greater concorde and harmonie can not be imagined, then is proportioned by the freendly vnitie of diuers and contrary. He sawe lykewyse in the same, suche a mutuall compassion of parte to parte, and member to member, by one common sense existent in them all, that no one part or member can feele eyther ioy or payne, but that in manner all the other are partakers thereof more or lesse, yf they be lyuely members, and not wythered, or otherwyse vnsensate by reason of dead flesshe, which onely by cuttyng and burnyng ought to be deuided from the sounde and whole. But as in man (whom Plato calleth the lesse worlde) the vigour and agilitie of the immortall soule and mynde, neuer ceasseth from continuall mouing, but is euer exercised in excogitations and inuentions of great thynges (herein resemblyng GOD, whose caracte it beareth) by prouidence foreseeing, and by intelligence vnderstandyng, and deuising what is to be done, and what to be eschewed, dooth immediatly moue and rayse vp the faculties, powers, and members of the body to execute the same: Euen so, in the greater worlde, the prouidence of God, and vniuersal counsayle and consent of men, hath elected and appoynted certayne principall men, to beare lyke rule and authoritie in the body of the common wealth, as hath the intellectiue soule in the members of our body to moue and commaund the same. To Princes therefore, Counsaylours, Rulers, Gouernours, and Magistrates, as to the most intellectiue and sensitiue partes of the societie of men, hath God and nature geuen preeminence and gouernance of the common wealth, that by theyr prouidence, wysedome, and ayde, it may vniuersally florysshe, not onely by iuste administration of good lawes, with due correction of malefactours, but also by liberall rewardyng of suche as haue well deserued, and especially by mayntenaunce of suche Artes and Sciences, as the common wealth can not well be without. And to draw nearer to the applying of my similitude, I say, that what so euer vertue, what so euer art, or the ingenius industry of men, hath to this day inuented, all the same is to be imputed to the benenolence and liberalitie of

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ſuche as haue honourably mayntayned and freely rewarded the trauayles, paynes, and charges of them that haue ſpent theyr liues, goodes, and wittes (as many haue done) in the inuentions of neceſſarie and profitable artes and ſciences. For euen as wholeſome and temperate ayre, with ſeaſonable weather, and fauourable influence of the heauens and planettes, cauſeth frutefulneſſe on the earth, and contrarywyſe, barrennelſe by the contrary: Euen ſo the fauoure of Prynces and Magiſtrates, nouriſheth, augmenteth, and amplyfieth, all artes and ſciences by liberalitie, and extinguiſheth the ſame by miſerable couetouſneſſe and parcimonie. And although in ſome men of rare and noble nature, the deſyre of honour and fame, onely for vertues ſake, and ſtudie towarde their countrey and common wealth, hath mooued them in maner to their owne vndooyng, through theyr great loſſe and hynderance, to ſet fooryth and inuent diuers thyngs for the commoditie of the common wealth and other, rather then for their owne: yet vndoubtedly, who ſo wel conſyderyth, and indifferently wayeth that I haue layde, ſhall fynde and ſee by dayly experience, that in maner onely munificence, liberalitie, and rewarde or the hope therof, geueth ſpurres to them that attempt great and vertuous enterpryſes, as I coulde more largely proue by ſo many teſtimonies of hiſtories, both holy and prophane, that the rehearſall thereof ſhoulde be but tedious, and not greatly neceſſarie for my purpoſe, eſpecially wryting vnto your honoures and wooryhyppes, of whoſe munificence, and liberalitie, I haue had great experience, both in my ſelfe, and others, who by your ayde and mayntenaunce, haue attempted, and perfourmed many goodly inuentions, viages, nauigations, and diſcoueries of landes and ſeas, heretofore vnknowen.

Wherein, what great charges you haue ſuſteyned, and howe liberall and conſtant you haue been in furtheryng the ſame, dooth well declare, that hytherto you are rather loſers then gayners thereby. The whiche thyng doubtleſſe, is more to your commendatiō, in that it may hereby appeare that you haue attempted the ſame, rather for knowledge and vertues ſake, then for couetouſneſſe of gaynes: as is furthermore well knowen by your fyrſt viages of diſcouerie attempted to Cathay, by the North,

eaſt ſeas, vpon certayne loſſe & detriment, for vncertaine hope eyther of gaynes, or of any ſuche way to be founde, otherwyſe then by certayne lykely coniectures: not muche vnlyke to the ſhyning ſtowpes of Marchaſytes, whiche outwardly appearyng in minerall mountaynes, are ſignes and tokens whereby is coniectured what metall is contayned therein, and whether the ſame is to be followed or not. And although it ſometyme ſo chaunce, that ſuche ſignes are fayleable, ſhewyng more in appearance, then they conteyne in ſubſtaunce: yet are not ſuche ſignes, tokens, or ſhewes to be contemned, but rather earneſtly to be followed, for as much as it hath been often prooued, and found by experience, that by followyng the ſame, haue ben found great and ryche mynes of mettalles, as Georgius Agricola in his bookes De rebus metallicis, dooth largely declare and prooue by many examples. But to wryte at large what great thynges haue proceeded of ſmal and obſcure begynnynges, and in manner meere coniectures, it would ſo farre exceede the meaſure of an Epiſtle or Preface, that it woulde rather encreaſe to the iuſte quantitie of a booke. For in manner al the late diſcoueries both of the Spaniardes and Portugales, had their begynnyngs of ſuche ſmall coniectures, with vncertayne hope (as it were præter ſpem ſub ſpe) vntyl GOD and good happe, by the conſtant trauayle and valiaunt mynde of ſuch as fyrſt attempted the ſame, gaue them to enioye that they hoped for. But what ſo euer they haue obteyned, and doo enioye, this may I boldly ſay in your behalfe (ryght honourable and worſhypfull) that there hath not lacked in you eyther the lyke or greater promptneſſe of mind, forwardneſſe in attempting, magnificence in expences, and liberal in rewardes. For beſyde the great charges, and loſſes that you haue ben at otherwyſe, what ſhould I ſpeake of ỳ great giftes that you haue ſent to the Emperour of Ruſſia? What of your laſt chargeable viage of diſcouerie among the innumerable Rockes, Ilandes, and moueable mountaynes of yce in the froſen ſea, by innumerable landes & Ilandes vnknowen to the Antiques euen vnder and farre within and beyond the circle Artike, where they thought that no lyuyng creature coulde drawe breath or lyue for extreeme colde: whereas

wheras neuertheleſſe the ſame hath been by you diſcouered, euen vnto the mighte ryuer of Ob, that falleth into the Scithian Ocean, or Oceanus Hyperborei. not farre from the mountaines called Hyperboreus, ſo named, be cauſe they are ſituate almoſt vnder the Northe Pole, and thought therfore to be inacceſſible. A voyage doubtleſſe of ſuch difficultie, and in maner impoſſibilitie, that conſyderyng the infinite dangers thereof (as I haue learned by thinformatiõ of Steuen a Burrough, that was then the cheefe Pilot of the ſame voyage) it may ſeeme impoſſible that they ſhould euer haue eſcaped, except the mighte hand of God, by the expert ſkylfulneſſe of ſo excellent a Pilot, had delyuered them from thoſe dangers. And although in deede (as religion byndeth vs) it is conuenient in al thynges to geue al honour, glory, and thankes to God: yet are we not thereby reſtrayned to be thankful to ſuch men. as by their art, ingeniouſineſſe, trauayle, and diligence, haue deſerued both iuſt commendation and large rewarde. And therefore referryng the rewarde to you (ryght honorable and wooryhypful, to whom it appartayneth) yf I ſhould not here geue hym at the leaſt ſuche commendation as in my iudgement he hath well deſerued, I myght ſeeme both to defraud hym of his wooryhy deſertes, & alſo to forget the freendſhyp and good wyll I beare hym, only for his vertues and excellencie in his profeſſion. For certaynely when I conſider how indigent and deſtitute this Realme is of excellent and expert Pilottes, I can doo no leſſe of conſcience, then, in reſpecte of your owne commoditie, yea rather for the commoditie of the Queenes Maieſtie, and the whole Realme, to exhorte you, and put you in remembrance (although I may herein ſeeme to put the Spurres to a runnyng Horſe, as ſayth the Prouerbe) ſo to regard hym. and eſteeme hym, and his faythfull, true, and payneful ſeruice toward you, that he may thereby be further encouraged, and not diſcouraged, eyther for lacke of maintenaunce, or otherwyſe by the iniurious aſſaultes of ſuch his enimies, as onely his vertues and excellencie haue mooued to beare hym diſpleaſure, as enuie doeth euer folowe vertue, as ſayth the Latine Prouerbe, Virtuti comes inuidia. And howe true a ſentence this is, is well verified by the ſaying of a

certayne Philosopher (whose name I do not remember) who hearyng one vaynely reioyce that he had no enimies: answered, that that was a token he had doone litle good: meanyng thereby (as dayly experience prooueth) that yf he had excelled in any vertue, he coulde not haue lacked some enimies. And hauing here touched to speake of enuie, I remember that when I was a young scholer, I haue read in the Poet Hesiodus of two kyndes of enuie, whereof the one is called Inuidia, and the other Aemulatio, whiche is more tollerable then the first, for that it is ioyned with some vertue, and enuieth that any shoulde excell him in any excellent qualitie that he professeth. But forasmuch as this enuie of emulation procedeth of some singuler vertue of them that are so maliced, they may herein reioyce, that they shal euer haue a hundred friendes for one enimie: yea and although they had none, yet is vertue a rewarde to it selfe, and to be embraced for it selfe onely, as the Philosophers affyrme. What then shal we say to suche, as forgettyng this rewarde of vertue, do not onely fauour, but rather hynder the preferment and mayntenaunce of such experte men, more esteemyng certayne Fyshermen that goe a trawlyng for fysh in Catches, or Wongers, and Dradgies for Oysters about the sandes, betweene the South furland & Wyntertonnesse, and the sandes about Temmes mouth, then they doo suche excellent Pilotes as are able without any Rutter or Carde of Nauigation, not onely to attempt long and farre vyages, but also to discouer vnknowen landes and Ilandes, as haue done of late yeeres many excellent men, to the great honour and enrychyng of theyr Prince & countrey. But as touchyng Steuen a Borough, the chiefe Pilot of your vyages of discouery, it may hereby wel appeare, that he is neyther malitious nor enuious of his Art and Science, in that he desireth the same, for the common profite, to be common to al men: and for the same intent was the first that mooued certaine worshipful of your company, as Syr William Garrard, Maister William Wericke, Maister Blase Sanders, and Maister Edwarde Castlen, to haue this worke translated into the English tongue. Who of theyr owne good nature, fauouryng all vertuous studies, and the professours of the same, dyd soone en-

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cline to his honest request herein, and therwith not only desyred me, but also with liberal rewarde entertained me, to take in hand the translation. Which beyng now finished as wel as my poore learnyng may performe, I desire your honours, & worships, to accept in as good part as I haue ment herein to gratifie you, and doo such seruice as my abilitie may suffice. Now therefore this woorke of the Art of Nauigation, beyng published in our vulger tongue, you may be assured to haue more store of skilfull Pilottes. Pilottes (I say) not Pirottes, Rulers, not Rouers, but suche as by their honest behauiour & conditions, ioyned with art and experience, may do you honest and true seruice: Which is not to be looked for of suche as beyng destitute as well of the feare of God, as of all mortall vertues, superabounde in al notorious vyces, accomptyng desperatnesse for boldnesse, rashnesse, for hardines, impudence, for stoutnesse, & crueltie, for manhood. What other thyng (I say) is to be looked for of suche, then of such trees, such fruites, Et mali corui, malum ouum. But for as much as these haue no place appoynted them in the body of our common wealth, which we haue herebefore compared to the members of the body of man: therefore are they no otherwyse to be esteemed, then as excrementes of the body, to whom nature hath appoynted no place in the same, but laboureth continually to cast them foorth diuers wayes, least by their fylthynesse they should infect the other members, euen as the pompe of the shippe, yf it be not auoyded, is noyous to the shippe and al that are therein. But the wyse and honest Pylote, fyrst hauing before his eyes the feare of GOD, and puttyng his cheefe truste in hym, shal secondarily trust to his Art & Science, without any such vayne obseruations as the superstitious Horoscopers (Astrologiers I meane, and not Astronomers) are accustomed to vse in the elections of houres, tymes, and dayes, by constellations and aspectes of the Starres and Planettes, as many fonde men haue done, thynkyng thereby to haue escaped such daungers, as they haue thereby the rather fallen into, through contempt of Art and Science, by foolyshe confidence in superstitious Astrologie: whiche for the vanitie and vncer-

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tayntie thereof, the ryght woorshypful, and of singuler learnyng in al sciences, Syr Thomas Smyth, in my tyme the flowre of the Uniuersitie of Chambridge, and sometyme my Tutor, was accustomed to cal Ingeniosissimam artem mentiendi (that is) The moste ingenius art of lying. Omitting therefore the superstitious and phantasticall obseruations of the iudicials of Astrologie, it shalbe better & more necessarie for al Pilots that desyre to excell in their profession, to learne and obserue the principles of this Booke, whereby they may haue suche knowledge of the Sphere, as may instructe them the makyng and vse of diuers goodly Astronomicall instrumentes parteyning to the art of Nauigation, by knowledge of the mouinges of the Sunne and Moone in their Spheres, and the other Planettes and fyxt Starres: thereby to atteyne to the true knowledge of houres, tymes, and tydes, with the variation of the Compasse, and many other goodly naturall obseruations of weathers, tempestes, and calmes, by certayne infallible signes & tokens of the same, very necessary to be obserued, and this by the true principles of Astronomie, and not of Astrologie. And this is the true Astronomie, whereof the diuine Philosopher Plato hath written so diuine a sentence, that I haue thought the same here woorthie to be alleaged, that by the aucthoritie of so famous an aucthour, we may knowe what is true Astronomie, with the vse and commoditie thereof. Therefore in his booke entituled, *Timeus vel de Natura* these are his woordes.

Rerum autem optimarum cognitionem, nobis oculi attulerunt. Nam hæc quæ de mundo disputantur, nunquam inuenta fuissent, si neque Sydera, neque Sol, neque Cœlum, suscipe potuissent. Cognitio vero diei ac noctis, ab oculis orta, fecit vt dimensione quadam, mensium, annorumque ambitus metiremur, tempus cognosceremus, ac vniuersæ naturæ ordinem scrutaremur. Quibus ex rebus, Philosophiam adepti sumus.

That is to say, our eyes haue brought vnto vs the knowledge of most excellent thynges. For what so euer is disputed of the worlde, had neuer been inuented, yf neyther the Starres, neyther the Sunne, neyther Heauen, coulde haue been seene.

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For the knowledge of the day and nyght, taking begynning at the eyes, cauſed vs, as it were by certayne limits and boundes, to meaſure the circuites of monethes and yeeres, whereby we came to the knowledge of tymes, and the order of vniuerſall nature. And hereby alſo we obteyne the knowledge of Philoſophie. &c. And thus by the aucthoritie of diuine Plato (whom for his excellencie Cicero called Deum Philoſophorum, that is, the God of Philoſophers) we may vnderſtand, that the true Aſtronomie, is ỳ perfect knowledge of the miraculous mouynges of the planettes, ſtarres, and heauens (and eſpecially of the ſunne and moone) wherby is cauſed the varietie of tymes, & diuerſitie of al natural thyngs, by natural cauſes: as by the qualities of Elementes, as hotte, colde, moyſte, and drye, which are augmented or diminiſhed by the more or leſſe influence of theſe two Luminaries, as they come nearer vnto vs at ſometimes, or depart further from vs at other tymes, with diuers motions in diuers climates, which cauſeth not onely varietie of tymes in ſundrie climates, but alſo the varietie of diuers complexions, fourmes, and diſpoſitions of al creatures vnder the face of heauen, none other accidentall contingent, voluntarie, or violent cauſe, to the contrary notwithſtandyng. And this is it that Plato meaneth by theſe woordes, Vt tempus cognoſceremus ac vniuerſæ naturæ ordinem. &c. That is, to knowe the tymes and vniuerſal order of nature. And doubtleſſe, who ſo well conſydereth the marueylous effectes that are cauſed, eſpecially by the variable mouing of the ſunne in the Zodiacke, muſte needes acknowledge it to be the cheefe inſtrument and meane that God vſeth in the generation, preſeruation, and alteration of al creatures that are conteyned in the woorlde, of generation and corruption. And for this conſyderation, certayne of the auncient Philoſophers called it the ſoule of the woorld: Other, the eye: and other alſo, the hart of the woorlde. Plato alſo affirmeth, that the ſoule of the woorld is the ſunne, & that al other lyuyng thynges receiue lyfe from thence. And hereof commeth the ſaying of the philoſopher, Sol & homo, generant hominem: (that is) the Sunne and man, beget man. And therfore (as

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wryteth Marcilius Ficinus) of al idolaters they are moſt tollerable that honour the ſunne for God. The which, although it be not, yet vndoubtedly are his effects ſo great & wonderful in this inferiour world, that it may ſeeme in manner to be Gods Vicegerent, Lieſetenaunt, and Vicerop, in al the woorkes of nature, except where & when it pleaſeth hym in any thing miraculouſly, other wyſe then by the common order & courſe of nature, to commaunde the contrarie.

And yf it may not be tedious vnto you (ryght honorable and worſhyppfull) it ſhalbe a pleaſure vnto me, for the better declaration hereof, to make a briefe diſcourſe of the marueylous and ſtrange effectes that are cauſed by the ſunne: whiche perhappes fewe haue doone, otherwyſe then diſpearſedly here and there, as occaſion hath ſerued. Fyrſt therfore let vs conſyder what it hath doone ouer the Equinoctial lyne, and vnder both the Poles at one inſtant, yet diuerſly and contrarply the one to the other. For ſo hath the infinite wyſedome of the great God of nature, the ſupreame Architecture of the vniuerſall world, diſpoſed al thynges in ſuche perfect order, that to them that are vnder the Equinoctial, and haue theyr Horizon paſſyng by the two Poles, the day is of twelue houres, and the nyght as muche, and theyr yeere alſo is diuided into twelue monethes: But they that dwell iuſte and perpendicularly vnder our Pole, and that haue their Horizon paſſyng ouer the ſayde lyne, haue the day of ſyxe monethes: That is to ſay, begynnyng from the tenth day of March, when the Sunne commeth ouer the ſayde Horizon, vntyl it returne to paſſe vnder the ſame at the tenth of September. And contrarywyſe, one nyght of ſyxe monethes haue the inhabitauntes vnder the pole Antartike: whoſe yeere (that is to ſay, al the courſe that the ſunne maketh by the twelue ſignes of the Zodiacke) is accompliſhed in one day and one nyght: a thyng doubtleſſe moſt wonderful and marueylous: Lykewyſe, whē we haue ſommer, they that are vnder our pole, haue the day of ſyxe monethes, and they of the oppoſite or contrary pole, haue theyr night of the ſame length. Agayne, when it is wynter with vs, then vnder our Pole is the nyght of the ſayd ſyxt monethes:

and

and vnder the opposite Pole, is the day of the same length. So that, as it were, course by course, when we haue the nyght, they haue the day: and contrarywyse, when we haue the day, they haue the nyght. The which, although it be so long, & of so great space of tyme, yet is it not continually obscured with darknesse. For the Sunne maketh his course in suth order, that the inhabitauntes of that parte, lyue not duryng that tyme altogether in darknesses, as Moles lyue vnder the ground, but as other creatures that lyue vppon the globe and face of the earth, they haue suche lyght as may suffyse to susteyne and manteyne their lyfe. For the body of the Sunne declyneth no more eyther beneath the Equinoctial lyne, eyther aboue the same lyne (which is the Horizon to both the Poles) then. 23. degrees, that is to say, no lower or higher then the Tropikes, which are no more then. 23. degrees, or there about, from the sayd Equinoctial, that is their Horizon, as is aforesayde. And yet in these. 23. degrees, he maketh not his course by the opposite Diameter, but goeth continually round about in circuite: so that his beames reuerberatyng heauen, represente suche a manner of lyght, as we haue in Sommer, two houres before the Sunne ryse. And this example which we haue taken of the diuersitie of the Horizons of the Equinoctial, and vnder the two Poles, is to demonstrate the marueylous effect that the Sunne maketh, departyng from the. xii. houres of the Equinoctiall (that is to say, from Aries, to Libra) and commyng by little and little, illuminatyng the Globe of the earth, and so reducing the yeere of. xii. monethes, into one onely day, and one nyght, as is sayde before. Under the infinite varietie of the which course, sometime with long daies, and sometime with shorte, al the Inhabitauntes of the worlde are fourmed and disposed, of such complexion and strength of body, that euery of them are proportionate of the Climate assigned vnto them, be it hotte or colde, and may dwell and abyde there, as in their naturall place, and temperament, not lamentyng, ordesyryng to dwell elswhere, so great a loue resteth in them to theyr natiue situation. But not to departe from the vyage whiche the Sunne maketh in one whole yeere, as sometyme

approchyng

approching neare vnto vs, and sometyme departyng from vs, I say, that at one selfe same tyme, in diuers partes vpon the round Globe of the earth, it causeth the Spryng, Sommer, Autumne, and Wynter. And neuertheleſſe, at the ſame inſtant and punct of tyme, it maketh day and hygh noone in one place, and nyght and mydnyght on the oppoſite parte. The whiche varietie, although it appeare incomprehenſible to the ſlenderneſſe of our wyttes, yet beholdyng the ſame with the eyes of vnderſtanding, and therewith conſyderyng the ineſtimable mouing that the Sunne maketh continually, we ſhall fynde it to be true, hauing reſpect to the diuers ſituations of the earth, as it is continually illuminate more or leſſe by the Sunne. And this varietie is made with ſuche a harmonie and conſonancie, and ſuch a lawe perpetuall and immutable, that yf any poynt or pryncke thereof ſhoulde fayle, it is to be doubted leſt the Elementes ſhould be confounded togeather, and returne to their firſt Chaos.

And to haue ſayde thus muche of the woonderful effectes of the courſe of the Sunne, it may ſuffiſe for an example to proue how neceſſary a thyng it is, not onely for al Pilots & Sea men to haue the knowledge hereof, but alſo for al other ſuche as ſhall attempt great and farre voiages in vnknowen landes, & ſtrange countreys, as dyd of late Maiſter Ienkynſon, a woorthy gentleman, ſet forth by you, and mayntayned at your charges, more lyke an Ambaſſadour ſent from any Prince or Emperour, then from a companie of Merchant men. Wherein, what commendation you haue deſerued, to the increaſe of your perpetual fame and honour, I referre it to that I haue ſayde before. And as touchyng Maiſter Ienkinſon, what trauayles, paines, and dangers he hath ſuſteined, and hardly eſcaped, and what diligence and art he hath vſed in the ſearching of ſtrange countreys, and in the deſcription of thoſe his voyages, it were but in vayne for me to wryte muche vnto you, vnto whom the ſame is better knowen then to me. And therefore to conclude, with renderyng iuſt commendations both vnto you and hym, I can ſay no more, but as Plato wryteth in his Booke *De Legibus*. Decens eſt eos ciues laudibus ornare, qui corporis vel animi viribus, res arduas præclaras que geſſerunt, & legibus libenter paruerunt.

That

That is to say, It is decent to commend those Citizens, that by theyr industrie of body and mind, haue doone great affayres, and haue wyllyngly obeyed good lawes. And thus eftsons desiryng your honours and worshyppes to accept in good parte whatsoeuer I haue sayde of good wyll and affection toward you and your proceedinges, and with your shielde of iustice and auctoritie, to defend me agaynst the assaultes of suche as are enimies to vertue, and captius of other mens doynges, I rest at your commaundement to the vttermost of my power, to do you what seruice I may.

(.'.)

¶ The Epistle Dedicatorie of Martin Cortes, to the most mightie and victorious Monarch Charles the Emperour, the fifth of that name, King of Spayne.

SO greatly were esteemed the inuentours of certayne Artes and Sciences in auncient tyme (as wryteth Saint Augustine in his bookes De Ciuitate Dei) that they tooke them not for mortal men, but honoured them as immortall gods. Isis arryuing in Egypt, ordeyned common weales with iust gouernaunce, gaue them lawes, and knowledge of letters, and taught them also the vse of Flaxe. In consideration wherof, she was honoured of suche as then knewe her, and reuerenced of them that came after her: In so muche, that they establyshed a capitall penaltie or punyshment of death, agaynst all suche as eyther in sporte or in earnest affyrmed her to be an earthlye woman, and not rather a diuine Goddesse. Ceres beyng of lyuelye wit and cleare vnderstandyng, beholdyng in the Cicilians humane similitude and shape to the outwarde apparence, and inwardly the fiercenesse of bruite beastes: brydeled their customes, and refourmed them with newe Statutes, teachyng them to tame Oxen to beare the yoke, to sowe Wheate for their great commoditie, to grynde in the Mylle, to kneade in the house, and to bake in the Ouen. In recompence whereof they made sacrifice vnto her, and buylded many sumptuous Temples in honour of her. Saturnus commyng from Creta, gaue lawes vnto the Latines, whereby they myght gouerne themselues, and prescribed them maners of lyuyng, teachyng them to Tylle and Manure the grounde, and sowe Corne, and to geather rype fruites in due season. And yf Saturne were profitable to those nations, and they not vnthankefull vnto hym, in that they buylded hym aulters, celebrated vnto hym festiuall dayes, and accompted hym in the number of the heauenly Goddes, namyng

The first inuentours of Artes.

Isis.

Ceres.

The Cicilians.

Saturne gaue Lawes to the Latines.

Tillage of the grounde.

hym also the father of the Gods. And (yf I say) he was to them so profitable, and that worlde iudged so happie and prosperous for hauyng so valyaunt a Kyng, and so iust a Lawe geuer, that it was therfore by the mouthes of al men called the GOLDEN WORLDE, and RAIGNE OF SATVRNE: Certes, except I greatly deceyue mee selfe, this our tyme is nothyng inferiour to that. For we knowe certaynely that your Maiestie hath been more profitable to Spayne, then euer was Saturne to the Latines: and also a more excellenter Lawe geuer, in maner to all Europe, and further, to the newe worlde, lately discouered, then he that gaue Lawes but onely to a lytle corner of Italie. Whereby I consider, that the felicitie of your Maesties tyme, hath been no litle commendation to your dooynges, in that you haue banyshed vice, honoured vertue, punyshed offendours, and fauoured innocentes: so that the quiet haue thereby lyued more peaceably, the vnquiet restrayned, the good exalted, and the euyll chastised: In so muche that nowe, by reason of iust ministration of good order in your Maiesties dominions, they that walke in the nyght, goe in safetie, whereas we knowe, that in other Prouinces, suche as walke in the day goe in daunger and perill. And therefore in the most happie tyme of your maiestie, it appeareth that Spayne is renewed, not onely in the excellencie of Mechanicall or handy crafts, but also in the knowledge of letters and discipline of warre: In so muche, that shee that some tyme lacked her selfe, may nowe abundantly minister to her neyghbours that haue neede. And whereas to your imperiall Maiestie, it shoulde not suffice to defende your lawes, yf power and armes shoulde fayle to defende and punyshe: who, comparable to your Maiestie, enioyeth the one, and wanteth not the other, hauyng tryumphed ouer Kynges and Kyngdomes, enlargyng also the name of Spayne in many vnknowen and barbarous Landes and Nations? Greater duetie therefore owe your Subiectes vnto you, then euer dyd the Egyptians to Isis, or the Cicilians to Ceres, or the Latines to Saturne, for as muche as they haue receyued of your Maiestie more common and profitable benefites. It is not long since your Maiestie hath for-

The golden worlde, and raigne of Saturne.

The worthie factes of Charles the fifth.

Sicilia.

Spayne reformed.

The triumphs and victories of Charles the fifth.

bydden

bydden and abolyshed the vse of Mules, and restoyed againe the exercise of armes, so long out of vse, that the one with the other, hath been no small profite and commoditie to your subiectes and dominions. For by takyng away the vse of Mules, is so encreased the number of Horses and Horsemen, that suche as before neuer durst or coulde in manner lyght vp vppon a Horse, can nowe easily and aptly manege them. So that you seeme to haue reuiued the dayes of Bellerophon the sonne of kyng Glaucus, and lykewyse the tyme of Saturne, when men had fyrst the knowledge how to make Horses to abyde to bridle, and to bring them vp to serue for diuers vses and necessities of men. And ryght sure I am, that by reason of suche laudable statutes and ordinaunces in your dominions, shall sayle neyther Horses nor Horsemen, aswell for the Courte, as for the campe. Who knewe in manner howe to gyrde a sworde, before that your Maiestie permitted weapons and armour to be worne, euen in your Courte, and that els where all men myght do the lyke: before which tyme dexteritie sayled, where courage abounded. Ouer and beside the profite and commoditie that hath ryssen hereof, what honour you haue obteyned by the same, is manifest by Frauncis the Frenche kyng, who by your Maiestie beyng taken prysoner in the parke of Pauia, was brought to Madrid, in the yeere a thousande fyue hundred twentie and fyue, where seeyng many young men in manner without beardes, and yet laden with armour and weapons, sayde, O happie Spayne, that bryngest sooth and nourishest men of warre. In your most happie dayes also, the Christian fayth is amplified, and in manner whole Spayne flourysheth dayly more and more in sumptuous buyldynges, and is abundantly enryched in treasure brought from your Indies, farre surmountyng the ryches of Solomon brought from Ophir. Yea and to say the trueth, conseryng the Nauies of golde & siluer, which haue been ordinarily brought from thence to your Maiestie, this tyme may rather be called the golden age, then that of Saturne. Not omitting also, that by your prosperous attemptes, haue been discouered so many landes and Ilandes, heretofore so vnknowen to the Cosmographers, Geogra-

Mules.

Horses and Horsemen.

Bellerophon.

Wearyng of weapons, and armour.

Frauncis the French king taken prisoner.

The Christian faith enlarged.

The sumtuous buildinges and ryches of Spayne.

The Indies nauies of golde and siluer.

New landes and Ilandes discouered.

phers, & Historiographers, that they neuer hearde of theyr names. Whiche neuertheleſſe are now ſo well knowen to your ſubiectes, that they haue troden them with their feete, and meaſured them by pales. Who before this tyme euer hearde any mention of the ryche and large Prouince of Peru, or of the ſtraytes of Magalianes, or of the ryuer of Syluer, called Rio de la Plata. They in tyme paſt ſeemed to haue doone no ſmall thyng, when they had knowledge of the fortunate Ilandes, the which, ſince they were conquered by your Maieſties Graundfather, haue been called the Ilandes of Canaria. And yf it be, and hath been muche to diſcouer and ſubdue this newe worlde: it is doubtleſſe no leſſe glorye to your Maieſtie, not onely to poſſeſſe and enioy it, but alſo that you daylye procure to ſende thyther Iudges to gouerne with lawes, and preachers to inſtruct in doctrine, to bryng thoſe Indians to the knowledge and honourynge of the true GOD. And therefore conſyderyng your Maieſties godly deſyre and purpoſe, as touchyng theſe Nauigations, and the daungers of ſuche as goe to diſcouer this newe worlde (although it be not newe to the Spaniardes to trauayle into farre Countries, for as muche as in the dayes of Caius Cæſar, the ſonne of Auguſtus, were founde broken peeces of Spanyſhe Shyppes, loſte in the gulfe of Arabie, as alſo Celius Antipater affirmeth, that certayne ſhyppes of Spayne were accuſtomed to ſayle for merchaundize to the Eaſt partes of Ethiope) in conſyderation hereof, haue I the more willynglye publyſhed theſe my trauayles, for the furtheraunce of all ſuche as ſhall hereafter attempte the lyke Nauigations. And here doo I not ſay that Nauigation is not a thyng of antiquitie. For we reade that in olde tyme the Argonanti ſayled to Colchos, and Danaus brought the fyrſt Shyppe from Egypt to Greece. But I ſay, that I am the fyrſt that haue brought the Arte of Nauigation into a breefe compendiouſneſſe, geuyng infayleable principles, and euident demonſtrations, deſcribyng the practiſe and ſpeculation of the ſame, geuyng alſo true rules to Mariners, and ſhewyng wayes to Pilotes, by teachyng them the makyng and vſe of inſtrumentes, to knowe and take the al-

Peru.
The ſtraights of Magalianes,
Rio de la Plata.
The fortunate Ilandes, or Canaries.
Religion in the Indies.
The Spaniardes haue euer trauayled into far countries.
The antiquitie of Nauigation.
Argonanti.
Colchos.
The Arte of Nauigation.
Thinges parteynyng to Nauigation.

titude of the Sunne, to knowe the tydes or ebbing and flowyng of the sea, howe to order their cardes and compasses for nauigations, geuyng them instructions of the course of the Sunne, and motions of the Moone: teachyng them furthermore the makyng of dyalles, both for the day and for the nyght, so certayne, that in all places they shall shewe the true houres without default: and haue lykewyse declared the secrete propertie of the Lode stone, with the maner and cause of the Northeastyng and Northwestyng (commonly called the variation of the compasse) with also instrumentes thereunto belongyng. And that, that which I shal say or doo, be not accompted to be presumptuously done or spoken, I acknowledge that whatsoeuer I haue wel doone or written, it is from aboue by the helpe of the diuine grace, and by the fauoure and prosperous fortune of your Maiestie. And thus shall they that nowe lyue, and lykewyse they that shall succede vs, see and perceyue, howe muche more the worlde oweth and is beholdyng to your Maiestie, then were the auncient Egyptians to theyr Isis. She gaue them letters to reade, but your Maiestie hath geuen rules and orders to saile on the seas. The profite of Isis was onely for one prouince. But the commoditie that ensueth of your doynges, is vniuersall for all prouinces and nations, and for all seas, aswel to go to places discouered, as also to discouer landes and regions yet vnknowen. If they of auncient tyme had reached that we haue obteyned, the Indies had not nowe been to discouer: neyther should it be esteemed a miracle vnto vs, as at the time when Carthage florished, that one Agnus went forth from the baye of Cadiz, and sayled to the ende of Arabie. Neyther woulde Cornelius Nepos haue written it for so famous a thyng, that a certayne man flying from kyng Latinus, came from the gulfe of Arabie: Whereby it is manifest, that aswell Nauigation, as other artes, doth from day to day increase, and by lytle and lytle is come to perfection. For in those dayes they had neyther compasse nor carde of saylyng whereby to gouerne them selues. They lacked the consideration of the starres, vntyl the Phenitians

The lode stone, falsly called in Englysh Adamant, is in Latine called Magnes.

Charles the fift greater then the Heroes of olde tyme.

Vniuersal benefites.

Comparison with the antiques.

Plinie

Nauigations of olde tyme.

The perfections of Artes this day.

The rudenesse of the antiquities.

tians founde the knowledge thereof, and were the fyrst that vnderstoode (that to suche as shoulde trauayle by sea) it shoulde be necessarie to lyft vp their eyes to heauen, and consyder the motions thereof. They that sayled to the Iland of Taprobana, (whiche in olde tyme was called Antitono) caryed for theyr voyages byrdes. And when they thought good, let certayne of them flee: and by the flyght of theyr wynges, directed the helme and sayles of their shyppes. They sayled onely three monethes in the yeere. To them therefore it was necessarie to obserue and tarrie the tyme, vntyll they founde it to serue with a forewynde. They knewe not howe to helpe them selues with the bowe lyne, or syde wynde: neyther sawe they the northy starre, or sought it, or had any knowledge thereof. And I beleeue verily that this was the cause of so long a voyage whiche the shyppes of Solomon made, sayling to Tharsis and Ophir, wherein they spent three yeeres: although in deede that was no short voyage whiche they made, compassyng about India, and many other prouinces. And whereas before I sayde, that Nauigation by lytle and lytle came to perfection, I fynde by auncient hystories, that Typho fyrst founde the Gouernal or Rudder, Dedalus the Maste and Shrowdes, and Icarus the Sayles, the Thirreni founde the vse of the Anker of one graspe or flooke, & Palaminus brought it to perfection, addyng the other. And thus may it manifestly appeare, that in these prosperous and fortunate dayes of your Maiestie, it hath pleased GOD to bryng the knowledge of Nauigation to perfection, with this my breefe discourse as touchyng the same, aswell profitable and necessarie for them that trauayle by lande, as by sea. What can be a better or more charitable deede, then to bryng them into the way, that wander? What can be more difficult, then to guide a shyppe engoulfed, where only water and heauen may be seene? One of the foure most difficult thynges, whereof Solomon maketh mention in his prouerbes, is the voyage of a shyp by the sea. The which Galfrede expounding, sayth, that in humane thynges, none is more fearefull or more dangerous,

Augurium.

The North Starre.

The voyages of Solomon to Tharsis and Ophir.

The first inuentours of Nauigation.

Commodities & difficulties of nauigation.

then

then to aduenture lyfe in a weake and thynne peece of wood, or for a man to commit him selfe to the rage of furious windes, among the tempestes of the sea, and there to hasard that he loueth so well. O how muche more shoulde the same seeme difficult to Solomon, yf at these dayes he shoulde see that fewe or none of the Pilotes can scarsely reade, and are scarsely of capacitie to learne? And whereas in the fyrst Chapter of this booke, I haue made mention, that the gouernall or sterage ought to be committed to expert men, and of good vnderstandyng, he should see, that now a dayes, the ignorant presume to gouerne other, which were neuer able to rule or gouerne them selues. I most humbly desyre your Maiestie, to receyue in good part this my poore seruice, whiche, although it be lytle, yet beyng directe vnto the greatnesse of your regal person, it shalbe much more then great. The profite and commoditie thereof, is notorious, and the benefite that thereby may be receiued, is vniuersall. If therefore, when your Maiestie shal find your selfe released from greater affaires, it may please you to feede your eyes with these my trauailes, you shal fynde therein many newe, delectable, and witty things, with also many profitable and certayne rules, both to reade & vnderstande. To conclude, I eftsoones make humble petitions to your Emperial Maiestie, not so muche to consyder what I wryte, as to respect the intent of my wrytyng: and not the gyft, but the affection & good wyl that remayneth in me to serue your Maiestie.

The ignorance of Pilottes.

The gouernal.

The first part of this woorke, which intreateth of the composition of the worlde, and of the vniuersall principles for the Art of Nauigation.

¶ The fyrst Chapter, of the general distinction of Creatures.

Three differences of creatures.

Corporal creatures.

THE infinite God, the beginning, and cause of the whole vniuersal, created three orders of creatures, differyng in kynd: that is to say, Corporall, as the Elementes, Spirituall, as Angelles, and compounded of these two, as Man. The corporall nature is diuided into bryght and shynyng bodyes, as the Starres: or into darke and thicke bodyes, as Earth and Mettalles: eyther into Diaphane or transparent bodyes, as Ayre and Water. Of these creatures (as sayth Saint Gregorie) some haue onely beyng, as Stones, some lyue, as Trees, and other haue sense, as Beastes, other vnderstandyng, as Man, who in holye Scripture is called all Creatures, accordyng to the saying of Christe to his disciples, where he sayth, *Goe and preache the Gospell to all Creatures*. And therefore not without good cause was man called of the Greke Philosophers, Microcosmos, (that is) *the lesse worlde*. In the whiche we contemplate thinges of no lesse admiration, then in the great worlde. The similitude betweene them both, is, that euen as the great world, and the whole Globe or Sphere thereof, is mooued by the voluntarie motion of an intellectiue substaunce, or an Angel: euen so is this. For (as Aristotle writeth) What so euer is mooued, is moued by vertue of an other: as Man is mooued by the internall or inwarde fourme that is within hym, (that is to say) by the intellectiue soule that is proper vnto hym. In like manner, in the great worlde are found diuers mooueable thynges: All which are reduced to one immoueable

Man is called all creatures, and the lesse worlde.

Man compared to the worlde.

All that mooueth, is mooued by an other immouable.

The intellectiue soule.

ueable moouer. So in man are founde many thynges mooued by diuers motions, which are al referred to his intellectiue soule. The great worlde conteyneth the creatures within it selfe, and consequently is all really, as hauing nothing without it. Euen so, man by knowledge is al, and knoweth al things, and nothing naturally is hyd from him, or vnknowen to hym. Agayne, in this lesse humane worlde, are two motions, Intellectiue and Sensual. Then consequently the great worlde hath two locall motions. The one, wherewith the fyrst mooueable is mooued, and draweth with it all the other Spheres from the East to the Weast, and is called Rationall mouyng. The seconde, is the mouyng of the other Spheres, from the Weast into the East: and is called Irrational mouing. But now leauing to speake of the lesse world, we wyl proceede to speake further of the greater.

Man knoweth part of all thynges.

Two motions in man.

Primum mobile.

Rational motion.

Irrationall motion.

The seconde Chapter, of the definition of the worlde.

THE worlde (as sayth Isodorus) is heauen and earth, and the other woorkes of God that are conteyned therein. It is compounded of thyngs visible, and yet vnsearchable. Moses and Saint John the Euangelist witnesse, that it was made by GOD. The Philosophers called it Mundus a mouendo, because it is in continuall mouyng, and neuer in rest. The Greeks called it Cosmos, whiche signifieth, Fayre, or Beautiful, and so named it, because of the marueylous ornament thereof, and diuersitie of Elementes, with the resplendence or shynyng of the Sunne, Moone, and Starres. And doubtlesse, nothing may be seene with the corporal eyes of man, more beautifull then it is. In so muche that the diuine Philosopher Plato affyrmed, that eyes were geuen to men to beholde the beautie therof, and to take pleasure in the contemplation of the heauenly bodyes, and roundnesse of the worlde, whiche also for the roundnesse thereof, is called Spherical, because that Sphera in the Greke tongue signifieth a rounde body.

What is the worlde.

Or Mundus à Munditie. *That is, clearnesse, or fayrenesse.*

Eyes were geuen to men to beholde the fayrenesse and beautie of the worlde.

The roundnes of the worlde.

The

The thyrde Chapter, of the definition of the Sphere.

Definition of the Sphere.

THeodosius sayth, that the Sphere is a whole and corporall figure, vnder one superficial: in the middest whereof, is a poynt or pycke, from the whiche al ryght lines drawen directly to the circumference, are equall.

The center of the Sphere.

This poynt or pricke, is called the center of the Sphere, according to Euclide, it is the passage of the circumference of halfe a circle, whiche is turned rounde about his Diameter that is fixed, vntyll it returne to his owne proper place agayne, as where it was at the fyrst. By the center of the Sphere, passeth a ryght lyne, and the extremities or endes thereof, touch in the circumference. And this lyne (imagined) is called the Axis, or Exeltree of the Sphere, and the endes thereof are called the Poles. Vppon this Axis is the Sphere of the worlde moued.

The Axis and Poles of the worlde.

The fourth Chapter, of the diuision of the worlde.

IT is to be presupposed, that there is difference betwene Element, and Elementate, and the fyfth, beyng called Quinta Essentia. The Quint essence, or fyfth substance, is a body of it selfe, differyng from all Elementes, and thynges Elementall, aswel in matter as in fourme, and no lesse in nature and vertue: and hauyng in it selfe no contrarietie, is certaynely without corruption. And hereof commeth it, that the Philosophers called the heauens and heauenly bodyes, the fyfth substaunce, or fyfth essence, by reason of the incorruptibilitie thereof. Element is that, whereof any thyng is compounded. It is the fyrst of compositions, and of it selfe is not compounded. Whereby it foloweth, that neyther the earth, the ayre, the water,

Quinta Essentia.

Aristotle calleth it the .v. Element.

The v. Essence is incorruptible.

What is Element.

The inferiour Elementes are not pure nor simple.

water, nor the fyre, that are neare vnto vs, or about vs, are pure and simple Elementes. For these Elementes doo sometymes mingle them selues one with another, and especially where they are neare togeather, and touche one another. Of these elementes euery part is named by the name of the whole: As euery parte of fyre, is called fyre, and euery parte of earth, is called earth, and so of the other. They are called simple bodyes, in respecte of other compounde and myxt bodyes. They are diuisible into partes of diuers fourmes: and of the commixtion of them, are made and engendred diuers thynges of sundrye kyndes. These foure (that is to meane, Earth, Ayre, Water, and Fyre) although they are named simple, but in respecte as aforesayde, yet are they the Elementes (that is to say) begynnynges and principles of all other compoundes and myxtes. A pure Element can not be seene, forasmuche as that that is pure, lacketh colour: and that that hath no colour, is not visible. The Elementes (as sayth Isodorus) were diuided by the hand of GOD. The imperial Heauen was replenyshed with Angelles, the ayre with byrdes, the sea with fyshes, and the lande with men, and other beastes. Elementate, is euery body compounded of the foure Elementes. Not that they are Elementes formally, but vertually in myxt bodyes. This knowen, we wyll shewe how the worlde is diuided into two regions: Celestiall, and Elementall. The region Elementall, which is continually subiect to alterations, is diuided into foure Elementes: which are, Earth, Water, Ayre, and Fyre. These Elementes, the Greekes cal Ydogia, for the communion and concord that they haue betweene them selues. The heauenly or etherial region (called Quinta Essentia) compasseth and conteyneth the Elementall worlde within it.

The elementes are diuisible into partes.

The commixtion of elementes.

Pure & simple elementes can not be seene.

The diuision of elementes.

What is elementate.

Diuision of the world into Celestiall and elementall.

Quinta Essentia.

The fyfth Chapter, of the number, order, and propertie of the Elementes and Heauens.

The

The orders of Elementes.

THE earth (after the Philoſopher) is a pycke or poynt in the middeſt, called the center, to the whiche they aſſigne the loweſt place. Next vnto the earth, and about it, the water occupieth the ſeconde place, and the ayre the thyrde. The fyre is hygher then any of the other elementes. And it is to vnderſtand, that the water hath two ſuperficials. One, whiche is called concaue, or holowe: the other, conuex or embowyng. You may compare the inwarde part of the concaue to a dyſhe or a bolle, whoſe outwarde part is called conuex. As touchyng the concaue, the water compaſſeth about the earth, leauyng diſcouered that part that ſerueth for the reſpiration and lyfe of men, and other beaſtes. As concernyng whiche, ſome thynke that the Ocean ſea is hygher then the earth: and aſke the queſtion why the ſea couereth not the whole earth, and why the earth is not ſunke in the water? To this it may be a ſufficient aunſweare, that it hath ſo pleaſed the wyll of GOD, accordyng to the ſaying of the prophete Dauid: Terminum poſuiſti quem non tranſgredietur. neque conuertetur operire terram. That is, Thou haſt appoynted limittes, which it ſhall not paſſe, neyther ſhall it returne to couer the earth. Beſyde the wyll of GOD, whiche is the cheefe and ſufficient cauſe thereof, we ſay that nature faylyth not in her neceſſaries. For ſhe ſome tyme admitteth a lytle inconuenience, to auoyde a greater euyll: as when heauie thynges, whiche naturally ſhoulde deſcende, doo not onely not deſcende, but ryſe vp: And as alſo ſome tyme it chaunceth that fyre deſcendeth, and water aryſeth to fyll the voyde or emptie places, leaſte any where ſhoulde be founde voyde or emptie, whiche nature ſo greatly abhorreth. To this purpoſe, nature foreſeeyng the kindes of many thynges that coulde not elſwhere lyue then on the earth, neyther be conſerued within the water (as men, and other earthly beaſtes) determined before to make the earth not perfectlye rounde, contrarye to the nature thereof; whereof it ſoloweth, that it is not altogether

Earth.
Water.
Ayre.
Fyre.

The fourme of the water.

The Ocean Sea.

Pſal. 107.
Iob. 38.

The will of God, is the cauſe of cauſes.

Nature abhorreth emptines.

The earth is not perfectly rounde.

togeather couered of the water. And as (sayth Origen) the earth remayneth discouered of water, that it myght bryng foorth fruites, trees, and plantes. As touchyng the conuex aforesayde, the water and earth discouered, are conteyned vnder the concauitie of the ayre, whiche is diuided into three Regions, as the lowest, hyghest, and myddlemost. The lowest is hotte, by reason of the reflection or reboundyng of the beames of the Sunne, stryken backe by the earth. The hyghest also is hotte, by participation of the fyre, and nearenesse thereunto. The myddle region is colde, as is manifest by the snowe and hayle, engendred in the same. The ayre neare vnto the Region of the fyre, whiche is pure heate, doth neyther burne nor lyghten, because it hath no combustible matter, and so hath it power, and not acte. It is neare vnto, and reacheth the circle of the Moone, whiche compasseth it about. The heauen, or circle of the Moone, is next vnto the heauen of Mercuri: and Mercuri vnto Venus: Venus, vnto the Sunne: the Sunne, to Mars: Mars, to Iupiter: Iupiter, to Saturne, whiche is next, and reacheth vnto the heauen of the Starres, called the firmament, because that in it are al the Starres (except the planettes) firme and fyxt as a knotte in a table. The knowledge of the planets was had by seuen sundrie motions they haue among them selues, and by their course, not vniforme to that of the starres of the eyght heauen, because that some tymes the planettes appeare vnto vs toyned togeather, and some tymes diuided. The Christaline heauen compasseth about, or conteyneth within it the heauen of Starres. This Christaline heauen, is transparent, and perspicuous, as cleare water or glasse that may be seene through, by reason of the cleerenesse and pure substaunce thereof. It is by an other name called, the heauen of water, whereof holye Scripture speaketh, saying, Aquæ quæ supra cælos sunt, laudent nomen Domini. That is to say, Let the waters that are aboue the heauens, prayse the name of the Lord. It was created for the conseruation of corporall thinges, and to temper the heate engendred of the mouyng of the fyrste moueable, whiche beyng so great of bodye, that it not only compasseth al the Elementes, but also all the inferior heauens is

Diuision of the ayre into three Regions.

The highest ayre is incombustible.

The order of the heauens.

The firmament.

The planets.

The Christaline heauen.

The heauen of water.

Psalm. 148. Daniel. 3.

The mouyng of the first moueable.

mooued

mooued so swyftly, that it dayly perfectly mooueth all the aforesayde spheres. And least by reason of the great heate thereof, caused by his swyft motion, it shoulde consume inferior thinges, GOD ordeyned this Christaline heauen, that the coldenesse thereof myght temper the extreeme heate of the other. This Christaline heauen, reacheth vnto the first moueable heauen, called Primum mobile. And this reacheth to the Emperiall heauen, whiche is the twelfth, called Emperium, by reason of his cleerenesse and resplendence. This is not mooued, and is most perfect. The Philosophers had no knowledge hereof. But we beleeue by holy scripture, that suche a heauen there is, and the same to be the habitation of Angelles, and spirituall creatures. It is also called Cœlum Cœlorum, that is, The heauen of heauens: because it conteyneth and includeth within it al the other heauens. It is of greater clearenesse then all the other heauens, and was created immediatly with the Angelles. In this also remayneth the humanitie of Iesus Christe our God, and in dignitie aboue it. It conteyneth three holy orders or principalities, called, Hierarchias. Whereof the fyrst is called supercelestial, and hath in it also three orders, Seraphims, Cherubims, and Thrones. The seconde is called Celestial, and conteineth Dominations, Principates, and Potestates. The third, called Subcelestial, conteyneth Virtutes, Archangelles, and Angelles. And to conclude, it hath aboundance of all goodnesse and perfect felicitie, with priuation or want of all euyll. The heauen also giueth influence of constancie, stedfastnesse, and durabilitie to thynges, agaynst the sturabilitie and inconstancie of the other heauens: the order whereof, doth appeare in the demonstration folowyng

The coldnesse of the Christaline heauen.

The heauen of the first moueable.

The heauen called Emperium, is not mooued, and is the habitation of Angels.

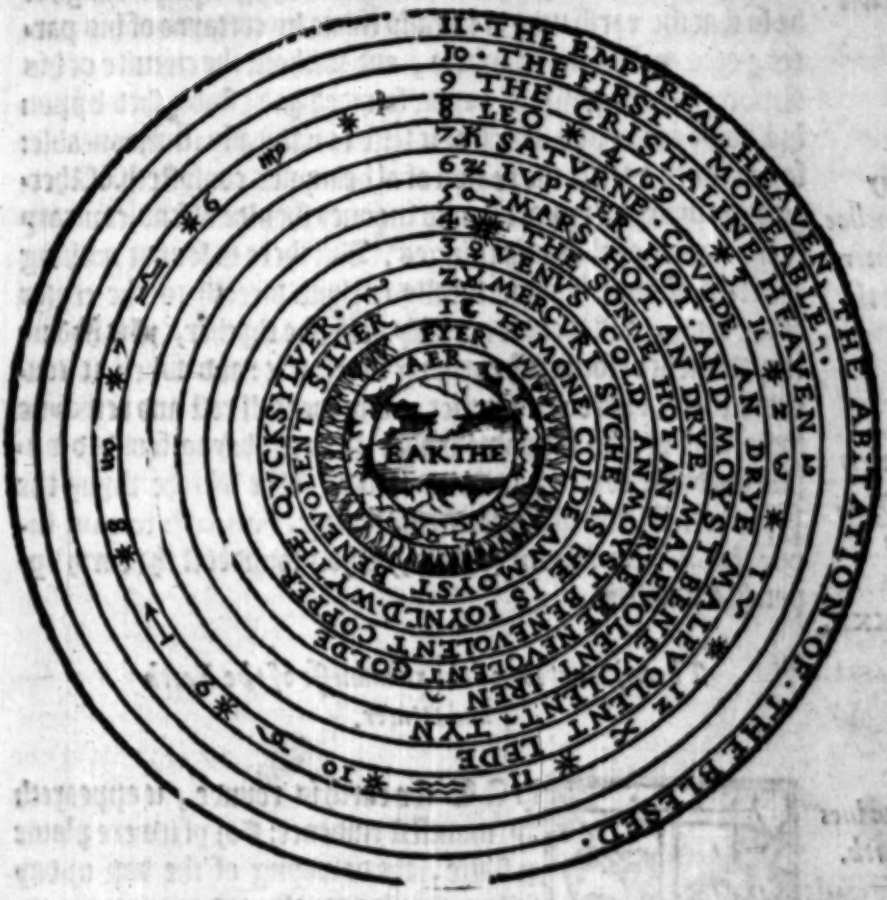
The humanitie of Christ in the Emperiall heauen.

Three orders of Angels.

The Emperial heauen preserueth all the other heauens.

(·)

The



The vi. Chapter, of the immutabilitie or immobilitie of the earth.

THE Pythagorians and other auncient naturall Philosophers (as sayth Aristotle) were of opinion that the earth dyd mooue, yet not by a ryght fourth motion, but circulerly about in the middest of one place. The which errour, both Aristotle him selfe, and the Astronomers do confute and reproue by euident causes, and manifeste demonstrations: For circuler motion,

Opinion that the earth mooueth.

Molus in loco.

The earth is immoueable.

motion, is proper to the heauens. And as the earth differeth from them in nature, ſo lykewyſe in mouyng. And although it be ſo that the earth may naturally moue by certayne of his partes, yet to moone in the whole, and without the circuite of his Sphere, it is impoſſible, beyng founded and eſtabliſhed vppon his owne center, the which of it ſelfe is naturally immoueable: for as much as in it the reaſon of al heauynes conſiſteth. Whereas otherwyſe, euery part that is mooued ſhoulde aſſend, contrary to the nature of al heaute thinges. But there is founde nothing heauie that dooeth not naturally enclyne directly to the center of the earth, and woulde actually deſſende thyther, yf it had no impediment of ſome other thyng to reſiſt it: and when it toucheth there, or is come thyther, woulde ſtyll reſt and remayne there. And hereby it followeth, that the earth, beyng founded vppon his owne center, is not mooued. The whiche thyng the Prophete Dauid alſo affyrmeth, ſaying, Fundaſti terram ſuper ſtabilitatem ſuam (that is,) Thou foundeſt the earth vppon his ſtabilitie.

All heauy thinges encline to the center of the earth.

The earth is founded vpon his owne center.

Pſal. Cxxx.

The. vij. Chapter, of the roundneſſe of the Earth and Water.

The roundnes of the earth.

THAT the earth is rounde, it appeareth by manifeſt euidence: For yf it were plaine or flatte, the dawnyng of the day or day ſpryng, ſhoulde equally and at one tyme appeare to them in the Weaſt, as to them in the Eaſt. But we ſee the contrarye, that it appeareth fyrſt to them that dwell in the Eaſt, & afterward to them in the Weſt. This is prooued by the Eclipſe of the Moone, whiche begynnyng at one inſtant, they of Hieruſalem ſee it begyn at foure a clocke of the nyght, and we of Andaluſie in Spayne, at one a clocke of the night. It followeth hereby, that to them it nighteneth three houres ſooner then vnto vs in Spayne: and this is cauſed by the roundneſſe of the earth. It is alſo as well knowen to be round, from the pole Artyke, to the pole Antartyke: for by the roundneſſe thereof, is

The ryſing of the Sunne.

The Eclips of the Moone.

cauſed

caused the equalitie and inequalitie of the dayes and nyghtes. The same is likewyse knowen by the raisyng of the Pole aboue our Horizon. And that the superficial part of the earth and water, is al one round & spherical Globe, is manyfest by the shadowe thereof, beyng a certaine darke body, reflected from the earth in ỳ Eclips of the moone. For by this, as by plaine demõstration, may we know that the earth is round, as may more manifestly appeare by this fygure. It is also proued, that the water is a round body, as is seene by experience. For yf you erecte a marke vpon the sea banke of a Porte, and a shyp departe from that Porte a certayne space: then standyng in the poupe or sterne of the shyp, you shal not see the marke aforesayde: but yf you stande in the top of the shyp, thẽ may you see it. Whereas notwithstandyng, (yf that portion of the bendyng Arke of ỳ earth, byd not hynder the syght) you shoulde see it better beyng in the poupe, for as much as it is nearer to the marke then is the top of the shyp, as by this demonstration following appeareth.

The equalitie of the dayes and nyghtes.

The earth and the water are one rounde Globe.

The water is a round body.

Howe the earth is round.

But here ſome may moue a doubte, ſaying, that on the earth we may ſee many mountaynes, and conſequently many great valleyes and playnes, with many diuerſities of ſundrie other deepe and vnequall places, by reaſon whereof, the earth can not truely be called round. To this I ſay, that in two manners, the earth is called and vnderſtoode to be rounde. As after one manner, ſpeakyng preciſely, it is called rounde, as a Circle or a Sphere, whiche we call round, becauſe that al rpght lynes drawen from the center thereof to the circumference, are equall. The other roundneſſe, is conſydered without this preciſeneſſe and is ſuche, as not by al his partes is equally diſtant from his myddeſt or center, but hath ſome partes hygher, and ſome lower, yet not in ſuch quantitie as may deſtroy the roundneſſe of the whole. As yf in a bowle there were certayne clyftes or holes, it ſhoulde not thereby leaue to be rounde, although not perfectlye or preciſely rounde. And for this cauſe ſayth Auerrois. that although both the heauenly bodyes & the elementes are of round fourme, yet dyffer they in this, that the heauenly Spheres haue perfect roundneſſe, and the Elementes not. As the earth, by reaſon of his mountaynes and dales, the ſea by his encreaſyng, and decreaſyng, the ayre alſo for his neareneſſe to the fyre, & by his contrarietie doeth ſometyme doo, and ſometyme ſuffer (that is to ſay) is ſometyme actiue, and ſometyme paſſiue. So that folowyng the one, it fleeth the other, by reaſon whereof, it alſo lacketh perfect roundneſſe. But the fyre, for as muche as it is neare to the concaue of the circle of the Moone, which is Spherical, may therefore be called Spherical or rounde.

The ayre is actiue & paſſiue, and not perfectlye rounde.

The fyre is rounde.

The

The. viii. Chapter, of the motion of the heauens and Elementes.

IT is not to be forgotten, that all the Elementes are wholy moueable by locall motion, except the earth. The water is moued by the motion of the Moone, or tolled by the wyndes. The fyre (as sayth Aristotle) is mooued circulerly by the motion of the day, and is drawen of the circles that embrace it, or compasse it about: as is manifest by the Cometes, or blasyng starres, and other syerie exhalations, conteined and engendred in it: Whiche being caryed with this motion, conclude, that the fyre mooueth in lyke manner. And with this motion is the superior part of the ayre violently caryed about, as the other impressions therein do shewe. The inferior part is mooued by diuers motions: (that is to meane) laterally, as by experience we see when the wyndes blowe. The Moone with her heauen or sphere, by her proper motion geueth her turne from the West to the East, in xxvii. dayes, and seuen houres. with xlv. minutes. Venus, Mercuri, and the Sunne, in a yeere, which is the space of three hundred threescore and fyue dayes, with fyue houres, and fourtie and nine minutes. Mars in two yeeres. Iupiter in twelue yeeres. Saturne in xxx. yeeres. The eight heauen, whiche is the fyrmament, or starrie heauen, by his owne proper motion is mooued by the nienth heauen, vpon the begynning of Aries and Libra, and vpon these two poyntes accomplisheth his reuolution in seuen thousande yeeres.

Howe the fyre is mooued.

Howe the ayre is mooued.

The Moone.

Venus.

Mercuri.

The sunne.

Mars.

The starrie heauen or fyrmament.

The Chrystaline heauen.

This motion is called Motus trepidationis (that is to say)

the tremblyng motion, or motion of accesse and recesse. The nienth heauen endeth his motion from the West to the East, in fourtie and niene thousand yeeres. And by this motion moueth the eight heauen. The tenth heauen, called Primum mobile, is moued from the East to the West: and in twentie and foure houres (whiche is a natural day) perfourmeth one reuolution, and with the myghtie force and swyftnesse of his motion, caryeth with hym al the other inferior heauens, and maketh them to geue the same turne in twentie and foure houres, where as neuertheles they ceasse not in the meane tyme to keepe the course of theyr owne proper motion. As (for example) yf an Ant or Pismire shoulde goe about the wheele of a Mylle, contrary to the mouing of the wheele: before the Ant in going still forwarde, shoulde come agayne to the poynt from whence she fyrst departed (whiche is once about, or one turne) the wheele shoulde in that space make many turnes.

Fyrst moueable.

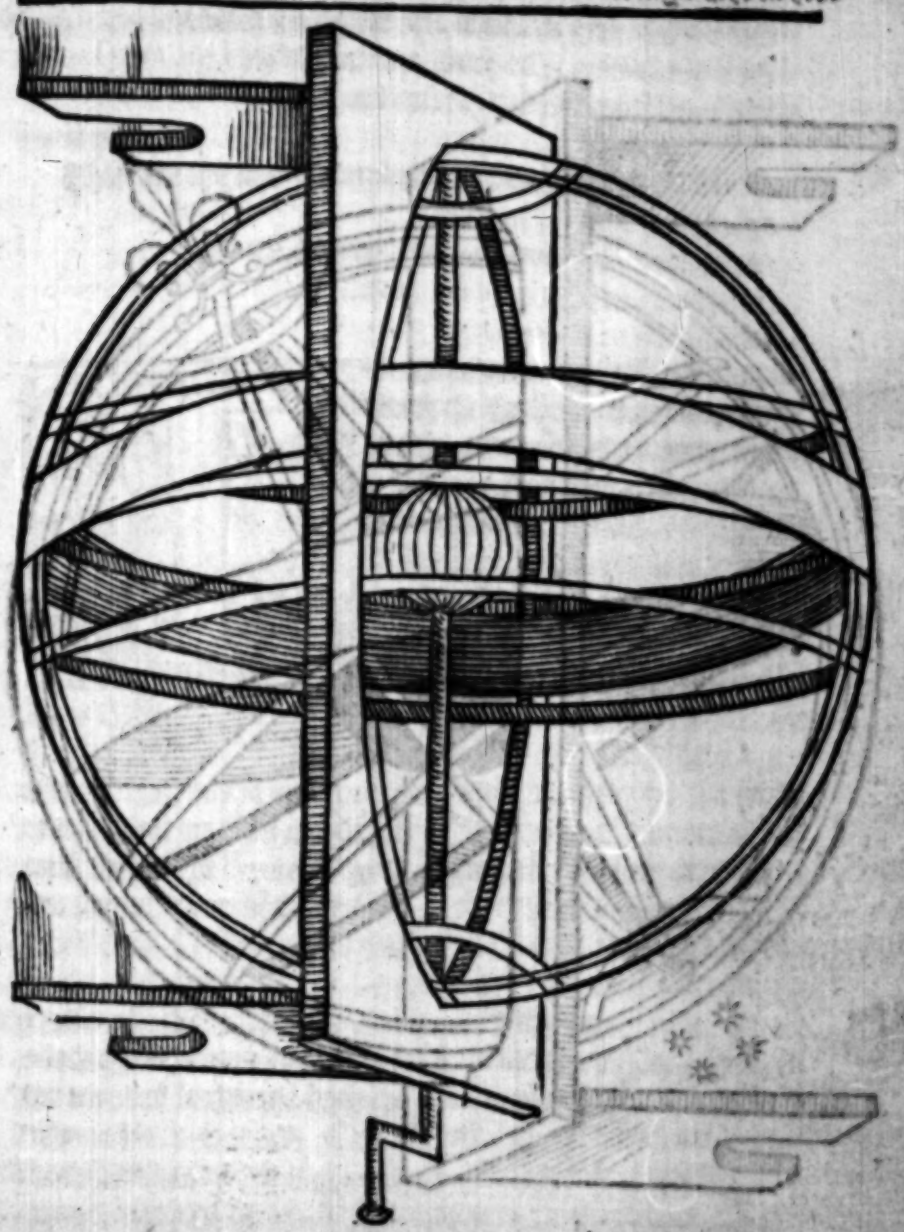
Howe the first moueable draweth the other heauens.

The. ix. Chapter. of the diuision of the Sphere into formall partes.

THE Sphere of the worlde, is diuided in two manners (that is to say) by substaunce, and by accident. By substaunce into tenne Spheres, as we haue sayde. By accident, into a right Sphere, and oblique or crooked Sphere. They haue the ryght Sphere that dwell vnder the Equinoctial line, and is called ryght, because to them the Poles are equally in the Horizon, as appeareth by this figure folowyng.

The ryght & crooked or oblique Sphere.

The



They haue the oblique Sphere that dwell eyther on this syde or the other syde of the Equinoctial, vnto whom is euer one of the *The oblique or croked Sphere.*

the poles aboue the Horizon, and the other vnder it ; as appeareth in this figure.

The .x. circles of the ſphere. The ſphere is compounded of x enne circles imagined. And (as ſayth Iohn de ſacro boſco in his booke of the ſphere) ſyxe of

of them are greater, and foure lesse. The greater Circle, is that whiche deuideth the Sphere into two equall partes, and hath his center with the center of it. These are the Equinoctial, the zodiacke, the two Coluri, the Horizon, and the Meridian. The lesse Circle, is that that deuideth the Sphere into two vnequal partes.

These are the two Tropykes, and two Poler Circles.

The. x. Chapter, of the Equinoctial Circle.

The Equinoctial.

THe Equinoctial, is a Circle that deuideth the Sphere into two equall partes, and is by euery parte equally distaunt from both the Poles. It is one of the greater Circles in the Sphere, and is the greatest Circle of those whiche are discribed in the Sphere, by the motion of Primum mobile, or first moueable. This Circle, for his equalitie, and regularitie, is more noble then the zodiacke, which we haue described in the eyght sphere, and also then any of the other. It is imagined to gyrd the world round about by East and West. It is called Equinoctiall, because this word Equinoctium, signifieth equalitie of nyghtes and dayes, whereof the cause is, that the Sunne comming to this Circle, the Arke of the day is equall with the Arke of the nyght, and then is the Equinoctial. It is also called the zone, or gyrdle of the firste moueable. For euen as a gyrdle dooth gyrde a man by the myddest, so doth this Circle gyrde in the myddest betweene both the Poles, vpon the which the fyrst moueable is mooued. One of these imagined on our part of the Sphere, is called Polus Arcticus, because it is neare vnto certayne starres, which the Astronomers cal Arcturus, whiche is ỹ great Beare. It is called Septentrional, or Septentrion, because that round about it are moued the. vii. starres, whiche make the lesse Beare, commonly called Bozina. (that is, the

The equalitie of the day and nyght.

The first moueable.

The Pole Artyke.

The horne. horne. The starre whiche is in the tayle of the lesser Beare, is
North starre. called the North starre, because it is nearest vnto the North Pole: the whiche Pole is a certayne poynt in the firmament, whiche can not be seene, although the night be neuer so cleare. This starre (as the Poet Homer saith) dooth moue lytle or nothyng, because of his litle distaunce from the Pole. The other
Pole Antartyke. Pole is imagined on the other contrary parte, and is called Polus Antarticus, of the woorde Ante, which signifieth agaynst, contrary, or oppolite, because it is on the contrary parte from the Pole Artyke. It is also called the South Pole, because that from that parte of heauen commeth the wynde, commonly called the South: and is lykewyse called Meridional, because it is ryght South from vs. This is neuer seene to vs. They that
The croſſe neare vnto the Pole Antartyke. dwel vnder the Equinoctial, or come nearer vnto this Pole Antartyke, haue for a ligne or marke to knowe it, foure starres, in fourme of a crosse. And when the greatest of these is lowest in the foote of the crosse, they say it is .xxx. degrees aboue the pole. And as we can not see they Pole from hence, so they can not see our Pole from thence.

The xi. Chapter, of the Zodiacke Circle.

Zodiack. THe Zodiacke is defined to declyne or bende it selfe from the Equinoctial. It is a great Circle, whiche deuideth ỹ Sphere in two equal partes, cuttyng the Equinoctial by oblique or crooked angles: So that beyng thus cut or deuided by it into two equal partes, one parte thereof declyneth towarde the South, & the other towarde the North. This Circle is called the zodiacke, of this woorde Zon, whiche in the Greeke tongue signifieth lyfe, because that accordyng to the mouyng of the planets vnder it, is the lyfe of inferiour creatures: Or is so named of Zodion, whiche signifieth a lyuyng beast. And is therefore diuided into
The twelue signes of the Zodiack. twelue

twelue equal partes, whereof euery parte is called a signe, and euery signe hath an especiall name of some beast, in respect of some propertie agreeable to the same: or for the order and disposition of the fixte starres in those partes, somewhat representing the similitudes of suche beastes, it is called zodiacke. The Latins called this Circle, Signifer (that is) the signe bearer, because it carryeth these signes or images in it also, because the twelue partes, into the whiche this Circle is deuided, are called the .xii. signes. That part which declineth to the North, conteyneth .vi. signes septentrional, and the other that declineth to the South, conteyneth other .vi. called Meridionall. Furthermore, it is to consyder, that the zodiacke may be deuided in two maners. One, by longitude or length into the .xii. signes afore sayd, and euery signe is deuided into .xxx. degrees, which make CCClx. degrees, lykewyse, euery degree is deuided into .lx. minutes, and euery minute into .lx. secondes, and euery seconde into .lx. terces, and so to forme. The other deuision of the zodiacke is, by latitude or breadth. By latitude it is deuided into .xii. degrees, and in it we imagine a lyne that deuideth his latitude by the myddest, hauing .vi. degrees on euery parte or side. And this lyne, which deuideth into two equal partes the breadth or latitude of the zodiacke, is called the Eclyptike lyne, because that when the Sunne and Moone are directly deuided vnder this lyne, eyther ioyned togeather by coniunction, or deuided by oppolition, then is the Eclipse of the Sunne or of the Moone. Vnder this zodiacke the seuen planets are mooued. The Sunne also moueth in the middest of the sayde zodiacke, alongest the Eclyptike lyne, not enclynyng more to the one part then to the other. But the other planets do sometyme goe towarde the North, and other whyles toward the South, and sometyme also towarde or trauerse the Eclyptyke. It is lykewyse to be noted, that these signes whereof we haue spoken, are not the constellations or starres that make those figures, which the auncient Astronomers did appropriate to certayne beastes, and other thinges: For these figures are mooued accordyng to the motion of the eygth sphere, and passe from one signe of the zodiacke to another. As we see that the starre, called Oculus Tauri.

How the sunne is cause of generation & corruption.

Deuision of the twelue signes.

Deuision of the signes into degrees.

Deuision of the Zodiack by latitude.

The Eclyptyke lyne.

The mooving of the sunne, and the other planettes in the Zodiack.

(that

The figures of beastes and other thynges imagined in heauen beside the .xii. signes.

(that is) the Bulles eye, is in two degrees of Gemini. And the two starres that are the head of Gemini, are in .xiii. and .xvi. degrees of Cancer. And Spica virginis. (that is) the spyke of the Virgin, is in .xvi. degrees of Libra, and the hart of Scorpio in two degrees of Sagittarius. And by this order doo they passe from one signe to an other: so that we may not vnderstande the signes by these starres, but the .xii. partes of the Arke of the zodiacke, takyng the begynnyng of the Equinoctiall of Aries. The names of these signes, with their caractes and qualities, are discribed in this table here folowyng.

Numb.	Names.	Charac.	Qualities.
1	Aries.	♈	Hot and dry.
2	Taur	♉	Colde and dry.
3	Gemi.	♊	Hot and moyst.
4	Cancer	♋	Colde and moyst.
5	Leo.	♌	Hot and dry.
6	Virgo.	♍	Colde and dry.
7	Libra.	♎	Hot and moyst.
8	Scorp.	♏	Cold and moyst.
9	Sagit.	♐	Hot and dry.
10	Capri.	♑	Colde and dry.
11	Aqua.	♒	Hot and moyste.
12	Pisces.	♓	Colde and moyst.

The .xii. Chapter. of the Circles, called Coluri.

Here are two circles in the sphere, called Coluri, so named of the Greeke woorde Colon, which signifieth, a member: And of Vros. whiche signifieth a wylde Oxe. The tayle of this beast, maketh a Semycircle, or halfe Circle, not perfecte. And as this beast mooueth his taile laterally or side waies,

and

and not by longitude reuen so doo the Coluri moue to vs, and are cut in ryght spherical angles, vpon the poles of the worlde. The one palleth by the poles of the worlde, and by the poyntes of the Equinoctials, and is called the Equinoctial Colure: the other lykewyse palleth by the poles of the worlde, and also by the poles of the Zodiacke, and by the poyntes of the Solstitials, and is called the Colure Solsticial, called Solstitium, as Solis statio (that is) the standyng or staying of the Sunne: because that when the Sunne commeth to this poynt, it declineth no more, but returneth towarde the Equinoctial. These circles diuide aswel the Equinoctial, as the zodiacke into foure equall partes, by the poyntes of the Equinoctials, and Solstitials. In the Colure Solstitial, are the greatest declinations of the Zodiacke, whiche are two arkes of this Colure, conteyned betweene the Equinoctiall and the zodiacke. And these arkes are equall to the other two of the same Colure, included betweene the poles of the worlde, and the poles of the zodiacke.

The Equinoctial Colure.

The Solstitial Colure.

The greatest declination of the Zodiacke.

The .xiii. Chapter, of the Meridian Circle.

THE Meridian, is one of the great Circles, imagined to trauerse the sphere by the poles of the worlde, cutting the same in two equal partes by the zenith or vertical poynt. It is called Meridian for this effect, that whersoeuer a man becommeth, and at what soeuer tyme of the yeere, when the Sunne (by the mouyng of the first moueable) shal come to his Meridian, to hym shal it be high noone at midday, and is therefore also called the circle of the midday.

Definition of the Meridian circle.

The midday or noone.

At

Diuers Meridians.

It is also to be noted, that there are as many Meridians, or Meridian lynes, as are differences or habitations by longitude: so that they that dwell in the east, haue other Meridians then they that dwel in the West: So that the interpolicion of the arke of the Equinoctial, betweene the Meridian of one citie, and the Meridian of the other, is called the difference of longitude from one region to another, and from one citie to another, as we wyl further declare hereafter.

The .xiiii. Chapter, of the Horizontall Circle.

Definition of the Horizon.

THE Horizon (after the Astronomers) is a Circle whiche deuideth that part of the heauen which we do see, from the other part whiche we see not, so that the sayd Horizon deuideth the sphere of the worlde into two equall halfes, called Hemispheres. That halfe whiche we do see, is called the Hemisphere superior, and it whiche we see not, is called the

Hemisphere or Horizon.

Hemisphere inferior. This Horizon, chaungeth to them that moue: for as one dooth moue, his Horizon dooth chaunge. And hereof it commeth, that howe many places are vpon the earth, and the circumference thereof, it is possible there shoulde be so many Horizons. The Astronomers suppose the Horizon, after two maner of sortes, that is to say, a ryght Horizon, and an oblique, or crooked Horizon. The ryght Horizon, is to them whose Zenith or verticall poynt is directly in the Equinoctiall: and this ryght Horizon, passeth by the poles of the worlde, and deuideth the Equinoctiall in right spherical angles: The other oblique or declined Horizon haue they, vnto whom the pole of the worlde dooth ryse aboue their Horizon. This Horizon is also called oblique, because it deuideth the Equinoctiall in vnequall and oblique or crooked angles.

Diuers Horizons.

The right and oblique Horizon.

Also

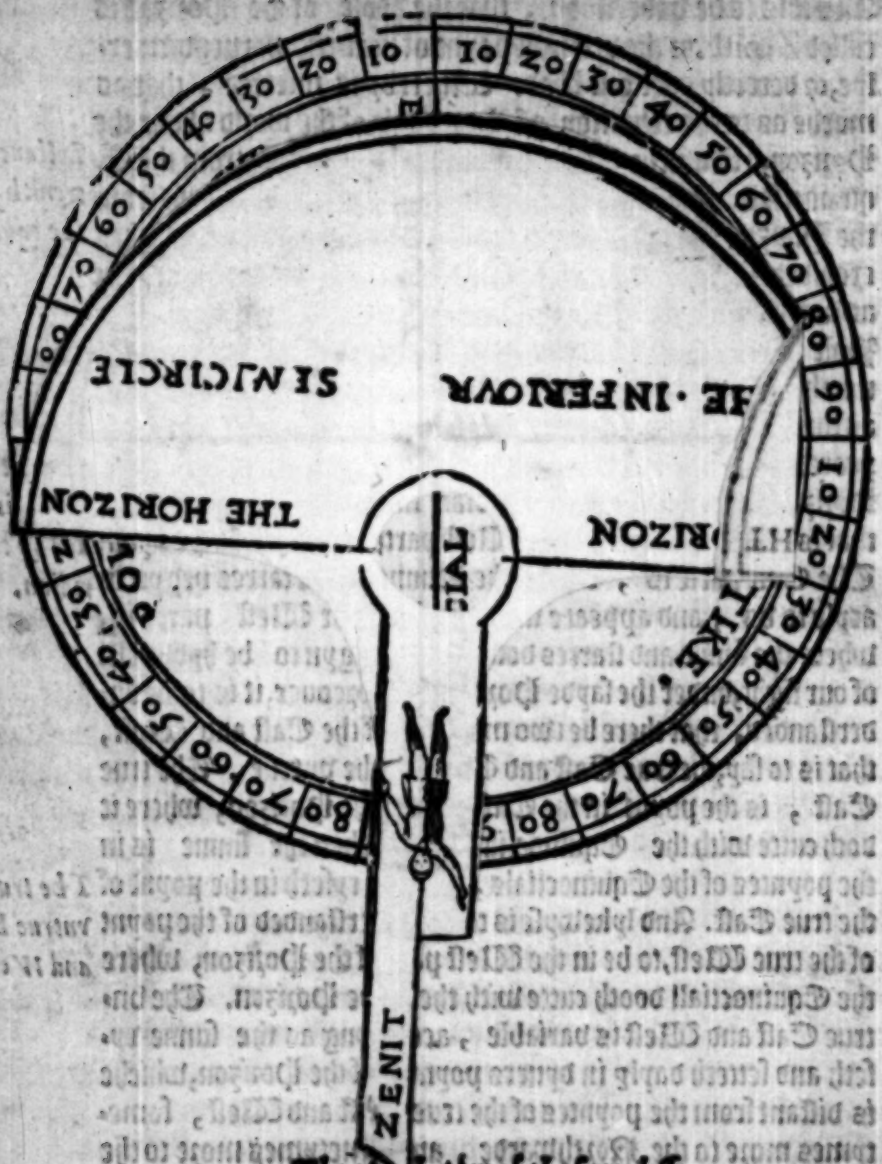
Also it is to be vnderstood, that the Pole of the Horizon is called Zenith, or the verticall poynt of heauen, perpendiculerlye, or derectly ouer our head. Wherebye is inferred, that as muche as is the elcuation of the Pole of the worlde aboue the Horizon, so muche is the distaunce of the Zenith from the Equinoctiall. For the Zenith by al his partes, is distaunt from the Horizon by nientie degrees. And all other impedimentes excluded, we may euer see halfe the heauen: And in as muche as anye shall passe from the Equinoctiall, towarde the one Pole or the other, so muche falleth his Horizon vnder or beneath the Pole, towarde the course he intendeth, and lykewyse as muche shall it be rayled aboue the contrary pole, as shal appeare by a demonstration in the ende of this Chapter. This Horizon is diuided by the Meridian into two equall partes, that is to say, the East and West partes of the sayd Horizon. The East parte is, where the Sunne and Starres begyn to aryse to vs, and appeare in our syght. The West part is, where the sunne and starres doth set and begyn to be hydde out of our sight, vnder the sayde Horizon. Moreouer, it is to be vnderstanded, that there be two maners of the East and West, that is to say, the true East and West, or the vntrue. The true East, is the poynt in the East part of the Horizon, where it doth cutte with the Equinoctiall: for when the sunne is in the poyntes of the Equinoctials, then he ryseth in the poynt of the true East. And lykewyse is to be vnderstanded of the poynt of the true West, to be in the West part of the Horizon, where the Equinoctiall dooth cutte with the sayde Horizon. The vntrue East and West is variable, accordyng as the sunne ryseth and setteth dayly in dyuers poyntes of the Horizon, whiche is distant from the poyntes of the true East and West, sometymes more to the Northwarde, and sometymes more to the South.

Distaunce of the Zenith from the equinoctial

Howe the Horizon is diuided by the meridian.

The true and vntrue East and West.

The



The.xv. chapter, of the foure lesse Circles.

The lesse Circles.

HAuyng entreated of the.vi.biggest circles, it remayneth to speake of the foure lesse circles.

A lesse circle (as we haue sayde before) is that, whose superficiall dyuideth the Sphere into vnequal partes, not passyng by the center thereof.

thereof. And of these, two are named Tropikes: so named of Tropo the Greke word, which signifieth *Conuersion*, because the sunne comming to any of these Troppkes, is conuerted, & turneth toward the Equinoctial. These Tropikes are described by the motion of the fyxt moueable, with the poyntes of the Solstitials. The one with the begynning of Cancer, and this is called the Tropike of Cancer, or Estiual, or Sommer Troppke. The other is described with the begynnyng of Capricorne, & is called the Tropike of Capricorne, or Hiemal, or winter Tropike. These two Tropikes and the Polar Circles (whereof I wil say more hereafter) are called Paralelles: so named, for that they are equally distant by their circumferences one from an other, as wel as from the Equinoctiall. The Polar Circles are described in this manner: so that as the Zodiacke declineth from the Equinoctial, so do the Poles of the Zodiacke decline from the Poles of the world. And as the eyght Sphere is moued at the motion of the fyxt moueable, so shal the Zodiacke moue, which is part of this Sphere. And the Zodiacke being moued, his Poles shal lykewyse moue aboue the Poles of the world. And as the Poles of the Zodiacke are distant from the Poles of the worlde. xxiii. degrees and a halfe (whiche is as much as the greatest declination) they shal describe certayne circles distaunt from the Poles of the worlde, in the selfe same. xxiii. degrees and a halfe. These Polar Circles, take their name of domination of that Pole of the world that is most neare vnto them, & therfore is the one called Arryke, & the other Antartike.

Trodykes.

Paralelles.

The Polar Circles.

The Poles of the Zodiacke. and Poles of the worlde.

The greatest declination of the Sunne.

Pole Artyke. and Antartike

***

The

The.xvi.Chapter, of the fyue Zones.

The Sphere diuidd into fiue Zones.

THe ancient Astronomers diuided ẏ sphere vnto v. zones. The first, from the Pole Artyke, to ẏ Circle Artyke. The second, from the Circle Artike, to the Tropike of Cancer. The third, from ẏ Tropike of Cancer, to ẏ Troppyke of Capricorne. The fourth, from the Troppyke of Capricorne, to the Circle Antartyke. The fyfth, from the Circle Antartyke, to the Pole Antartyke. Of these fyue zones, they haue certayne knowledge, that two of ẏ Poles were vnhabitable for extreme colde: and also that the burnt zone (called Torrida Zona) wherby the Sunne passeth by the myddest of them, shoulde be vnhabitable for extreme heate. That from the Troppyke of Capricorne, vnto the Circle Antartyke, they called desart, because they knew not that it was inhabited. And this our zone, that is, from the Troppyke of Cancer, to the Circle artyke, they called inhabited or habitable. And to haue more perfect knowledg hereof, it is to imagine, that the earth is diuided proportionally into fyue regions or portions, whiche answeare directly to the sayde fyue zones, as sayth the Poet Ouid in this verse.

Zones habitable and vnhabitable.

The diuision of the earth accordyng to the fiue Zones of heauen.

Totidemque plage, tellure præmuntur. (*that is,*)
And so many regions, are on the earth beneath.

Euery of these regions or portions of the earth, is situate vnder one of the fyue zones aforesayd. But whereas certayne men of auctthoritie haue moued the question, whether the earth vnder the zone, from the Troppyke of Cancer, to ẏ Circle Antartyke, is desart or no: Ptolome and the Astronomers affyrme, that it is vnpeopled. But Aristotle, Ouid in ẏ second of his *Metamorphoses*, Plinie also, and Iohn De Sacro bosco, affyrme the contrary: as for the more certainty therof, we know by thexperience of such as goe & come dayly from those partes. Moreouer then this, we knowe that that lande is not only wel replenished with people of good corporature, & of white colour, but the same to be also very ryche in golde. For they that sayle to the East Indies,

An errour of Ptolome and the Actronomers.

touche

touche in the cape of Buena speranza, or Caput bonæ Spei which is in this zone. Like wyse the land of Brasile, and the rowtynes of Rio de la Plata, with al the coast, vnto the straightes of Magalianes, euen vnto the. 54. degrees of the South part. This land was discouered by Magalianes, in the yere. 1520. or. 1521. wherby that is now wel knowen by sight, whereof Ptolome had no knowledge by heare say. The burnt zone (called Torrida zona) they also described to be vnhabitable, by reason of the great heate thereof, as Aristotle, Plinie, and in maner al other ancient aucthours affyrme: whereof the Poet Virgil wryteth thus.

The land of Brasile.

The straightes of Magalianes.

Quinque tenent cœlum zonæ, quarum vna corrusco.
Semper sole rubens, & torrida semper ab igne.

Whiche in the English tongue is thus muche to say in effect.

In zones fyue, the heauens conteyned be,
Whereof the one with burnyng sunne is red:
Scorchyng so the earth subiect to his degree,
That for the heate thereof it is vnhabited.

Lykewyse Ouide in his Metamorphoses, toucheth the same, saying.

Quarum quæ media est, & torrida semper ab igne. &c.

Yet that the burnt zone is inhabited, and well replenished with people that lyue there, we know we so certainely by the number of them that dayly passe to and fro the Indies of your Maiestie discouered, in your most happie dayes, that to say any thing to the contrary, it should be a manifest errour, & therfore is it greatly to be marueyled, that certaine wise men haue affirmed these partes to be vnhabitable: whereas neuertheless they had knowledge of Arabia Fœlix, Aethiopia, Taprobana, and diuers other regions situate vnder the burnt zone. Plinie writeth that a shyp came from the sea of Percia by ꝑ Ocean, round about Ethiope, and came to the pyllers of Hercules, which is nowe the citie of Cadiz, where at this present I write this briefe treatise. They of Guinea, Calicut, Gatigara, and Malaca, lyue all vnder the burnt zone, and many of them lyue very long. And doubtlesse, many thynges ought to persuade vs, that vnder the burnt zone, the earth is furnished with all thinges pertaynyng to the lyfe of man; for that in that region, or portion of the earth, is in manes

The West Indies.

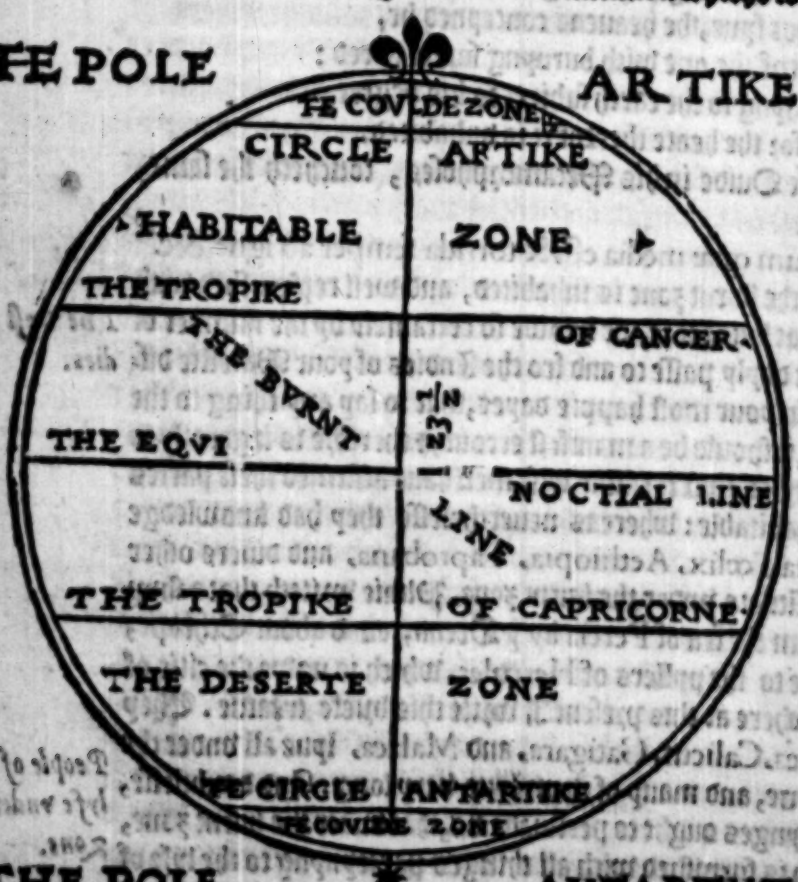
People of long lyfe vnder the Zone.

continuall Equinoctial, and the coldnesse of the nyght doth sufficiently temper the heate of the day. Agayne, they that inhabite vnder that zone, haue two Sommers, and two Winters in the yeere: whereby is concluded that the auncient auctheurs erred, not onely in affirming this zone to be vnhabitable by reason of the great heate thereof, but in lyke maner erred, in affirming the zone that is betweene the cirele Articke, and the pole Articke, to be also vnhabited by reason of great colde. The contrarie whereof, we may well affyrme, knowyng as we knowe, that Islande, with part of Gothland, Norway, Russia, and diuers other landes, are inhabited and wel peopled.

Colde regions habitable.

Islande.
Gothlande.
Norway.
Russia.

¶ This is the figure and demonstration whiche foloweth.



The. xvii. Chapter, of longitude and latitude, and of the *proportion which the lesse circles haue to the* great circle.

The diuision of the Sphere by longitude and latitude.

The sphere or globe of the earth, is also diuided in breadth, and in length. The breadth (which is called latitude) is by degrees: for from the Equinoctial, to eyther of the two poles, is. 90. Degrees. The length (which is called longitude) is by the degrees of the Equinoctiall, whiche is diuided in. 360. degrees. The fyrst degree of longitude, dooth begyn at a certayne Meridian, which passeth by the Ilandes of the Canares, called the fixed Meridian: and the order of the numbryng of the sayde longitude, is alwayes towarde the East. By euery degree of the sayde longitude in the Equinoctiall, may be vnderstanded a great circle (called Meridian) to passe, eche one of them passing and meeting in the poles of the world, so that the sayd great circles, or meridians, dooth diuide euery paralel or lesse circle, proportionally into. 360. degrees: but we must not vnderstande these degrees to be equal (that is to say) as great in one circle, as in another; for the greater the circle is, the greater is the degree in it: and the greater the paralel is, the nearer it is vnto the Equinoctiall lyne. Euery degree of the Equinoctial, conteyneth in longitude. 60. minutes, so lykewyse it is to be vnderstanded of the degrees of latitude, whiche be diuided eche one in. 60. minutes of latitude, because the degrees and minutes in the greater circles, doo not differ in they bygnesse the one from the other: but the degrees in the paralels, as they are nearer from the Equinoctial, & come neare to eyther of the two Poles, they diminyshe consequently, so that one degree in the paralel of. 7. degrees of latitude, dooth make in quantitie but. 59. minutes, and. 33. secondes of the Equinoctial circle: and in one degree in the paralel of. 12. degrees of latitude, goeth but. 58. minutes, and. 41. secondes of the Equinoctial, and in one degree in the paralel of. 16. degrees of latitude, there goeth but. 57. minutes, and. 41. secondes.

The degrees of the Equinoctial circle.

The table of minutes, which euery degree conteyneth in *euery of the paralelles.*

G	M	S	G	M	S	G	M	S	G	M	S	G	M	S	G	M	S
1	59	59	16	57	41	31	51	26	46	41	41	61	29	5	76	14	31
2	59	58	17	57	23	32	50	53	47	40	55	62	28	10	77	13	30
3	59	55	18	57	4	33	50	19	48	40	9	63	27	14	78	12	28
4	59	51	19	56	44	34	49	45	49	39	22	64	26	18	79	11	27
5	59	46	20	56	23	35	49	9	50	38	34	65	25	21	80	10	25
6	59	40	21	56	1	36	48	32	51	37	46	66	24	24	81	9	23
7	59	33	22	55	38	37	47	55	52	36	56	67	23	27	82	8	21
8	59	25	23	55	14	38	47	17	53	36	7	68	22	29	83	7	19
9	59	16	24	54	49	39	46	38	54	35	16	69	21	30	84	6	16
10	59	5	25	54	23	40	45	58	55	34	25	70	20	31	85	5	14
11	58	54	26	53	56	41	45	17	56	33	33	71	19	32	86	4	11
12	58	41	27	53	28	42	44	35	57	32	41	72	18	32	87	3	8
13	58	28	28	52	59	43	43	55	58	31	48	73	17	33	88	2	5
14	58	13	29	52	29	44	43	10	59	30	54	74	16	32	89	1	3
15	57	57	30	51	58	45	42	26	60	30	0	75	15	32	90	0	0

The. xviij. Chapter. of the circuite or compasse of the *earth and water, according to the opinions of the auncient and latter authours.*

IT may here appeare to be necessarie for our purpose, to declare what space of ꝑ superficitie of the earth or water, the auncient writers did suppose to answeare to one degree of a greater cirrle in the heauen: for in diuers countries, they vsed to count by diuers sortes or maner of measures: as, the Latines counted by miles, ꝑ Gretes by furlonges, ꝑ Spanyardes & Frenchmen, by leagues, ꝑ Egyptians, by signes or marches, & the Persians, by

Myles.
Furlonges.
Leagues.

by saguas. But they al agree, that foure graines of Barly make a finger breadth, foure fingers, a hande breadth, foure handes a foote, fiue foote, a Geometrical pase (for two simple pases, make fiue feete.) Also. 125. Geometrical pases, make a furlong, eyght furlonges, one myle, whiche is a thousande pases: and three myles, one leagüe. In Germanie they make leagües of moze feete, and in some places moze then in other. In Fraunce, they count thyrtie leagües, to one degree. The Spaniardes, count sixteene leagües and two terces, and seuenteene and a halfe for a degree of the great circle: this difference that one leagüe is bigger then another, may come hereof, that one Barly corne is bigger then another. But to our purpose, let vs geue to euery leagüe three thousand pases, and to euery pase fyue foote, and so shall euery leagüe haue. xv. thousande foote. In the Cardes of the sea, that haue their degrees of. xvi. leagües and two terces, we say, that of these, the roundnesse of the lande and the water, conteyneth sixe thousande leagües. And in the Cardes that haue seuenteene leagües and a halfe for a degree, of these we say that it conteyneth sixe thousande and three hundred leagües. And who so desyreth to knowe howe muche is the Diameter of the earth and water, may know it by multiplying the circumference by seuen, so that diuiding the summe that riseth thereof by twentie and two, the part that ryseth of that calculation, shalbe the Diameter: and the halfe thereof, shalbe the semidiameter.

Greyne.
Fynger.
Foote.
Pase.
The degrees of the sea Cardes.
The Diameter of the earth and water.

The. xix. Chapter. of the seuen Climates.

THE auncient auchours dyd also diuide that part of the superficie of the earth, on the South syde of the Equinoctiall, whiche they supposed to be most habitable, into seuen Climates, wherein they dyd fynde to be diuers conditions and customes of men, and diuersities of beastes, and of other natural thinges: the which thynges

Diuision of the earth and water by Climates.
Diuersities of thinges in diuers Climates.

thinges they perceyued to haue a diuerſitie in the countreys, as where the day of the one dyd encreaſe or differ aboue the day of the other by halfe an houre, ſo that the ſpace of the ſuperficiall of the earth betweene two parelelle lynes, wherein the longeſt day doth increaſe or differ by halfe an houre, is called a Climate. The place where they ſuppoſe the fyrſt climate to begin, is diſtante in Latitude from the Equinoctial by 12. degrees, and. 45. minutes, where the longeſt day is 12. houres, and 45. minutes, & the place where the laſt climate doth finiſhe, is in the Latitude of. 50. degrees, and. 30. minutes, where the longeſt day is. 16. houres, and 15. minutes, ſo that the increaſe of the longeſt day in the ende of the ſeuenth climate, dooeth exceede it in the begynnyng of the fyrſt climate by three houres and an halfe: and the whole compaſſe of the earth, with al the ſeuen climates, dooeth conteyne in breadth. 37. degrees, and. 45. minutes, but their length is ſuppoſed to extende vnto. 180. degrees of longitude. In that maner, a climate, the nearer it is vnto the Equinoctial, the more it conteyneth of the ſuperficiall of the earth, becauſe the paralelle cities, the nearer they be vnto the Equinoctial, the greater is the compaſſe of the earth whiche they make in length, and the leſſer the compaſſe is, the nearer they be vnto the poles, as dooth apeare euidently by the Meridians, where they doo all concurre, and meete in the poles, their diſtaunces betweth continually leſſer and leſſer, the nearer they be vnto the ſayde poles, ſo that the nearer the climate is vnto the pole, the leſſer it conteyneth of myles in the length. In lyke maner ſhall you vnderſtande, that greater is the breadth of the fyrſt clime, then of the ſeconde, and the ſeconde then the thyrde, and lykewyſe of the other. For in howe muche the more the Equinoctiall you come neare to the pole, ſo muche the more is the Sphere oblique or crooked, and conſequently the day encreaſeth more: by reaſon whereof in ſuche ſpace is founde the increaſe of halfe an houre, in whiche the climate maketh difference and doth varye. Whiche thyng ſhall be more manifeſt to hym that beholdeth the Latitude of them all, as may appeare by the Table here folowyng: In whiche you may ſee the houres whiche the greateſt day conteyneth of euery climate in his begynnyng, myddeſt, and ende,

What is a climate, Difference of dayes.

The ſpace of ſeuen climates

The quantitie of the leſſe climes.

The Latitude of Climates.

ende, with also the eleuations of the Pole, or distance from the Equinoctiall, and also the degrees of Latitude, which every climate conteyneth.

Climates.	The longest day. Beginning.		Midst.		End.	The eleuation of the pole. Beginning.		Midst.		End.		Differences of Latitude.		
	Ho.	M	Ho.	M	Ho.	M	G	M	G	M	G	M	G	M
1	12	45	13	0	13	15	12	45	16	40	20	30	7	45
2	13	15	13	30	13	45	20	30	24	15	27	30	7	0
3	13	45	14	0	14	15	27	30	30	45	33	40	6	10
4	14	15	14	30	14	45	33	40	36	24	39	0	5	20
5	14	45	15	0	15	15	39	0	41	20	43	30	4	30
6	15	15	15	30	15	45	43	30	45	24	47	15	3	45
7	15	45	16	0	16	15	47	15	48	40	50	30	3	15

The first climate, is called Dia Meroes. Meroe is a citie of Aphrike, vnder the burnt Zone, on this side the Equinoctiall 16. degrees. Dia Meroe.

The seconde, is called Dia Siena. Siena is a citie in the confines of Ethiope, where there is a well that sheweth the Sommer solstitial, because that place is vnder the circle of the Tropike of Cancer, and the Sunne seemeth to stande directly ouer that place at mydday of the solstitiall, whereby the well is then very cleare, and hath in it no shadowe at all: as the Poet Lucan maketh mention in Farsalia, where he sayth. Dia Siena.

Vmbras nusquam flectentes.

That is to say, shadowes no where reflectyng.

The thirde is, Dia Alexandros. Alexandria is a famous citie in Aphrike, buylded by great Alexander, and is the cheefe citie or Metropolis of Egypt. Dia Alexandros.

The fourth is, Dia Rhodos. Rodes is an Ilande of Asia the lesse, where were some tyme the Knyghtes of the Rhodes, called the Knyghtes of the order of Sayn John, or Knyghtes of Hierusalem, who were dayuen from thence, when the Ilande and Citie was taken by Solton Suliman the great Turke, in the yeere. 1522. Dia Rhodos

Knyghtes of the Rhodes.

The Rhodes taken by the Turke.

Philippe Vrlerio Frenchemann, beyng then graunde maister of the Rhodes. Within this fourth climate, is the Citie of Hierusalem, within the holy land called Palestina, and also a great part of Spayne, with many other prouinces.

Dia Romes. The fifth, is Dia Romes. Rome is the most famous citie of Italie, and most notorious of al Europe, sometyme the head of the worlde, dominatrix of nations, and nowe the sea of the Bishop of Rome.

Dia Boristhenes. The sixth, is Dia Boristhenes. Boristhenes is a great riuer of Scithia, the fourth arme of the riuer Istro. It falleth into the sea Euxinum: and where as al other riuers of Scithia are troubled, this is cleare and fayre, also wholesome to be dronke, and full of fyshe.

Dia Rifeos. The seuenth & last climate, is called Dia Rifeos. The mountaynes called Rifei, are famous in the part of Europe, called Parmatia, & are continually couered with Snow. Out of these, springeth the riuer Tanais, well knowen in the worlde by fame. *The riuer Tanais.* When it is written with ph. it is the name of certayne mountaynes of Archadia. And here ought we not to be ignorant, that whereas the authours assigned onely seuen climates, they myght haue made many more. And for that they iudged the parte of the Pole Antarctike not to be inhabited, they assigned no climates thereto. *Stoslerine.* Stoslerine added the eyghth climate, commyng from the ende of the seuenth climate, vnto 57. degrees and other added more. *The Meridian or South climates.* In like maner describyng Meridionall or South climates, we call them by the selfe same names, as we vsed the afore sayde Septentrionall, or North climates: sauyng that it is necessarie to put before euery of them, this Greeke proposition Anti, which in the Latine tongue, signifieth Contra, or Contrarium (that is) contrary, or against. So that as we named the fyrst North climate, Dia Meroes, we must to the fyrst of the South, adde this worde Anti, and so shall the first South climate be named Anti Dia Meroes. The seconde, Anti Dia Syenes, and so forth of the other, as is seene in the figure here followyng.

The

The xx. Chapter, of certayne principles, that ought to be knowen for this science.

TReating of the Sphere, we haue spoken of Circles, Circumferences, Centers, Diameters, Lynes, with such other wordes, appropriat to this science: The whiche, what they are, it is conuenient further to declare.

A ryght lyne, is a short extention from poynt to poynt. *A right line.*

An Angle, is the touchyng of lynes in one superficiall, *An angle.*

whole

whole touch shall not be direct: for if it be, it shalbe a lyne, and not an angle.

Solide. Solide is a body, whiche by denillians hath length, breadth, and depth.

A circle. A circle is a playne figure, contayned vnder a lyne drawen in compasse, in whose middest is a poynt or pricke, from the which al right lynes comming foorth to the circular lyne that compasseth it about, are equal.

The circumference of a circle. The circumference of a circle, is a lyne that contayneth the circle, (that is to meane) that lyne to the whiche all ryght lynes that proceede from the center of the circle vnto it, are equal: and this is called the roundnesse of the circle.

The center of a circle. The center of a circle, is that poynt or pricke from the which al ryght lynes proceeding vnto the circumference, are equal.

Diameter. The Diameter of a circle, is a ryght lyne, whiche passing by the center of the circle, and extendyng his endes to the circumference, diuideth it in two halfes.

Semicircle. The halfe circle, is a playne figure, contayned betweene the Diameter of the circle, and the halfe circumference.

Zenith. Zenith, is a poynt or pricke imagined in the heauen, directly ouer the toppe of any thyng, as, if we shoulde imagine a ryght lyne to passe by the center of the earth, extended from thence directy to heauen, and passing through the feete and head of a man standyng vpryght, so that the extremities or endes of this lyne, should reach vnto and touche the circumference of heauen: then the imagined poynt or pricke of heauen, where the ende of the lyne toucheth, is called zenith, or poynt of the head, or vertical poynt. The same is to be vnderstoode of a citie, or any other thyng, when we speake of the zenith thereof.

Eccentricke. Eccentricke, is a circle, which hath his center distant, or deuided from the center of the worlde, and is discribed in the heauen of the Sunne, imagining a lyne from the center of the Eccentricke, to the center of the Sunne, making a complete reuolution at the proper motion of the Sunne. In the other heauens, imagining a lyne from the center of his Eccentricke, to the center of his Epicicle, and beyng mooued a whole reuolution at the proper motion of the Epicicle.

The Epicicle, is a circle, or litle rundell fyxt in the depth of the Eccentricke: in whiche the Planet fyxed, and neare to his center, is mooued circularly. Epicicle.

The Auge, is a poynt in the circumference of the Eccentricke, nearest vnto the firmament: or it may be sayde, that the Auge is a poynt fardest distaunt from the earth. Auge in the Greeke tongue, is as muche to say, as the greatest longitude, or greatest situation from the earth. The Oppolite of Auge, is an other poynt in the circumference of the Eccentricke, nearest vnto the earth, and farthest distant from the firmament. Auge. *Oppolite of Auge.*

Here endeth the fyrst part.

The seconde part, intreating of the *Motions of the Sunne, and the* Moone, and of the effectes caused *thereby.*

The fyrst Chapter, of the course of the Sunne in *the Zodiacke, and of the effectes caused* by the same.

WE haue briefly spoken of the Sunne and of the other heauenly bodies. But for as muche as the Sunne must be our guyde, & gouernour in Nauigation, whereof we intend to geue perfect instructions, it shalbe necessarie especially, and precisely, to declare the course and motions thereof. Therefore (as we haue sayd) the Sunne is mooued vnder the Zodiacke, and vpon his poles in the lyne Eclypticke, passing by the xii. signes, begynnyng in the fyrst degree of Aries, where he maketh *The Sunne is the guyde in Nauigation.* *The mouuyng of the Sunne vnder the Zodiacke.*

keth Equinox, that is to say, he maketh the the day equal vnto the nyght in al places. Then from Aries, he entreth and mooueth into Taurus, approching nearer and nearer vnto vs on the North part, whereby the length of the dayes are increased with vs, and the nyghtes are shortened. Then entreth he into Gemini, and from Gemini into Cancer, where in the beginning of the first degree, he maketh Solstice, and toucheth the Sommer, or Estiuall Tropike, and then are the dayes longest with vs, and the nyghtes shortest. Then declineth he no farther from the Equinoctial: but returnyng towarde it, passeth by this signe, shortenyng the dayes to vs, and lengthenyng the nyghtes. From this signe of Cancer, it entreth into Leo, and passeth by it into Virgo, and by it entreth into the first degree of Libra, where he is in the Equinoctial, and then he maketh the other Equinox, so that the nyght is then equall vnto the day ouer all the worlde. And passyng by this signe, goeth declynyng from the Equinoctial towarde the pole Antartike, increasyng the nyghtes to vs, and shortenyng the dayes: and so entreth into Scorpio, and from thence into Sagittarius. And passyng by it, entreth into the fyrst degree of Capricorne, to the Hyemall or Winter Tropike: and then are the longest nyghtes vnto vs, and the shortest dayes. From hence he returneth towarde the Equinoctiall, shortenyng vnto vs the nyghtes, and lengthenyng the dayes. He passeth by this signe of Capricorne, and entreth into Aquarius: and passing by it, entreth into Pisces: and passing from thence, returneth to his fyrst poynt of the Equinoctiall of Aries, where he began. Hereby it foloweth, that as the Sunne goeth the halfe of the zodiacke on this part of the Equinoctiall, and the other halfe on the other part of it, and in these halfes hath diuers declinations, is caused the increasing or decreasing of the dayes and nyghtes, to one more, and to another lesse, accordyng as euery one with his Horizon discouereth of the course of the Sunne, by the lytle or muche that he is departed or distant from the Equinoctiall, or as the pole is raysed aboue his Horizon. So that when as to them that are on this part of the Equinoctiall, is the longest day and the shortest nyght: euen so to them

The Sommer Tropike.

Declination of the Sunne.

The Winter Tropike.

The cause of increasing and decreasing of the dayes and nyghtes.

on the other part, is the longeſt night, and ſhorteſt day. And contrarywyſe, when vnto vs is the ſhorteſt day, vnto them is the longeſt, whiche ſhall further appeare by euident demonſtration in the laſt Chapter of the thirde part.

The mouyng of the ſunne in the center of his ſphere.

The diſcreete Reader ſhall here note, that the Sunne is not mooued regularly in the Zodiacke, makyng ſo much by his proper motion in one day, as in the other, becauſe his reguler motion is in reſpect of the center of his owne proper ſphere or orbe wherein he is mooued, whoſe center is diſtant without the center of the worlde, toward that part of Cancer, ſo that the greater part of his orbe eccentricke, is towarde the ſeptentrionall part, where the Sunne paſſyng by the ſeptentrionall ſignes, is more diſtant from the earth, and hath more to goe of his orbe eccentricke, then being in the South ſignes: for paſſing by the North ſignes, he taryeth. 9 dayes more, to deſcribe that halfe of the zodiacke, then the other halfe towarde the South part, and for that cauſe the ſunne is more ſwyfter in his motion in the zodiack one tyme then another, for his motion in one day in the South ſignes, ſhalbe greater then it is in one day in the North ſignes, as ſhall appeare in the table that foloweth: whoſe vſe is, for the finding of the motion and true place of the Sunne in the zodiack for euery day of the yeere. And hereby it foloweth of the ſayde vnequal mouing of the Sunne, and by the obliquite of the zodiacke, certayne dayes of Winter, with their nyghtes, are longer then certayne other of Sommer, with their nyghtes: that is to ſay, that the day naturall in the Winter, doth ſurmount that in the Sommer, becauſe the ryght aſſenſion, whiche anſwereth to one dayes motion of the Sunne, beyng in the South ſignes, is greater then the aſſenſion for one dayes mouyng, beyng in the North ſignes.

The

The.ii. Chapter, of the true place of the Sunne in the Zodiacke.

To finde the true place of the Sunne.

The true place of the sunne, is a point or pricke in the Zodiacke, whiche is thus founde: that drawyng a ryght lyne from the center of the worlde, to the center of the sunne, & caryng the same continually right forth vnto the zodiacke, where this line sheweth or toucheth, that is the true place of the sunne. This place is found in three maners. One way, by a table: another way, by an instrument: and the thyrde way, by a certayne rule, to be borne in memorie. To finde the true place of the sunne by a table, seeke in the table folowing, the moneth that you are in, in the fronte or head of the table, and the dayes of the moneth, on the leaft side of the table. Then directly agaynst the dayes, vnder the tytle of the monethes, you shall finde two numbers, whiche are the degrees and minutes of the signe which you shall fyrst fynde, named ouer the head, or aboue the sayd numbers. Then to the degrees and minutes which you shal fynde, you shal adde the equation, that is directly of the peere in the whiche you are, or seeke to knowe. And this shall you seeke in the table of equations, which is after this: and that which sooth amount or ryse thereof, shalbe the true place of the Sunne. And here is to be noted, that in the common peeres (whiche are they that haue not the bisextile or leape peeres) from the ende of Februarie, vntyll the ende of the peere (I say of December) shall euer one degree be diminished or taken away: and the degrees and minutes that shall remayne, is the true place of the Sunne. How to know this by an instrument and by memory, shalbe sayd in the seuenth Chapter.

The equation of the yeere.

The Table of the true place of the Sunne.

Months.	January.		February.		March.		April.		May.		June.	
Signes.	Capricor.		Aquarius.		Pisces.		Aries.		Taurus.		Gemini	
Dayes.	☉	☽	☉	☽	☉	☽	☉	☽	☉	☽	☉	☽
1	20	22	21	53	20	55	21	24	20	21	19	55
2	21	24	22	54	21	55	22	22	21	18	20	52
3	22	25	23	54	22	54	23	21	22	16	21	49
4	23	26	24	55	23	54	24	19	23	11	22	46
5	24	27	25	55	24	53	25	17	24	13	23	43
6	25	28	26	56	25	53	26	16	25	8	24	40
7	26	30	27	56	26	52	27	14	26	6	25	37
8	27	31	28	56	27	52	28	12	27	3	26	34
9	28	32	29	57	28	51	29	10	28	0	27	31
10	29	33	☉♐	57	29	50	☉♉	8	28	58	28	28
11	☉♒	35	1	57	☉♈	49	1	6	29	55	29	25
12	1	36	2	58	1	48	2	4	☉♊	52	☉♋	22
13	2	37	3	58	2	47	3	2	1	50	1	19
14	3	38	4	58	3	46	4	0	2	47	2	16
15	4	39	5	58	4	45	4	58	3	44	3	13
16	5	40	6	58	5	44	5	56	4	41	4	10
17	6	41	7	58	6	43	6	54	5	38	5	7
18	7	42	8	58	7	42	7	52	6	36	6	4
19	8	43	9	58	8	41	8	49	7	33	7	1
20	9	44	10	58	9	39	9	47	8	30	7	58
21	10	45	11	58	10	38	10	45	9	27	8	55
22	11	46	12	58	11	37	11	43	10	24	9	52
23	12	47	13	57	12	36	12	40	11	21	10	49
24	13	48	14	57	13	34	13	38	12	18	11	46
25	14	48	15	57	14	33	14	36	13	15	12	43
26	15	49	16	56	15	32	15	33	14	12	13	40
27	16	50	17	56	16	30	16	31	15	10	14	37
28	17	51	18	56	17	29	17	28	16	7	15	34
29	18	51	19	56	18	28	18	26	17	4	16	31
30	19	52			19	27	19	23	18	1	17	29
31	20	52			20	25			18	58		

The Table of the true place of the Sunne.

Monthes.	July.		August.		Septēber.		October.		Nouēber		December	
Signes.	Cancer.		Leo.		Virgo.		Libra.		Scorpio.		Sagittari.	
Dayes.	☌	☍	☌	☍	☌	☍	☌	☍	☌	☍	☌	☍
1	18	26	18	2	18	4	17	39	18	49	19	24
2	19	23	19	0	19	2	18	39	19	50	20	26
3	20	20	19	58	20	1	19	38	20	51	21	27
4	21	17	20	55	21	0	20	38	21	52	22	29
5	22	14	21	53	21	58	21	38	22	53	23	30
6	23	11	22	51	22	57	22	38	23	54	24	31
7	24	8	23	48	23	56	23	38	24	55	25	33
8	25	5	24	46	24	55	24	38	25	56	26	34
9	26	2	25	44	25	54	25	39	26	57	27	36
10	27	0	26	42	26	53	26	39	27	58	28	37
11	27	57	27	40	27	52	27	39	28	59	29	39
12	28	54	28	38	28	51	28	39	♐	0	♑	40
13	29	51	29	36	29	50	29	39	1	1	1	42
14	♌	48	♍	34	♎	49	♏	39	2	3	2	43
15	1	46	1	32	1	48	1	40	3	4	3	45
16	2	43	2	30	2	47	2	40	4	5	4	46
17	3	40	3	28	3	46	3	40	5	6	5	48
18	4	38	4	26	4	45	4	41	6	8	6	49
19	5	35	5	24	5	45	5	41	7	9	7	51
20	6	32	6	22	6	44	6	42	8	10	8	52
21	7	30	7	21	7	44	7	42	9	11	9	54
22	8	27	8	19	8	43	8	43	10	12	10	55
23	9	25	9	17	9	42	9	43	11	13	11	57
24	10	22	10	16	10	42	10	44	12	14	12	58
25	11	20	11	14	11	41	11	45	13	15	13	59
26	12	17	12	13	12	41	12	45	14	16	15	1
27	13	15	13	11	13	41	13	46	15	18	16	2
28	14	12	14	10	14	40	14	47	16	19	17	3
29	15	10	15	8	15	40	15	47	17	20	18	5
30	16	7	16	7	16	39	16	48	18	22	19	6
31	17	5	17	5			17	49		23	20	7

The peres of our lorde	The equatiō to be added. G	M	The peres of our lord.	The equatiō to be added. G	M	The peres of our lord	The equatiō to be added. G	M	The peres of our lord	The equatiō to be added. G	M
1545	R 1	0	1581	1	16	1617	1	32	1653	1	48
1546		45	1582	1	1	1618	1	17	1654	1	33
1547		30	1583		46	1619	1	2	1655	1	18
1548		15	1584		32	1620		47	1656	1	3
1549	1	2	1585	1	18	1621	1	33	1657	1	49
1550		47	1586	1	3	1622	1	18	1658	1	34
1551		32	1587		48	1923	1	3	1659	1	19
1552		18	1588		33	1624		49	1660	1	4
1553	1	4	1589	1	19	1625	1	35	1661	1	51
1554		49	1590	1	4	1626	1	20	1662	1	36
1555		34	1591		49	1627	1	25	1663	1	21
1556		19	1592		35	1628		51	1664	1	7
1557	1	05	1593	1	21	1629	1	37	1665	1	53
1558		50	1594	1	6	1630	1	22	1666	1	38
1559		35	1595		51	1631	1	7	1667	1	23
1560		21	1596		37	1632		53	1668	1	9
1561	1	7	1597	1	23	1633	1	38	1669	1	55
1562		52	1598	1	8	1634	1	23	1670	1	40
1563		37	1599		53	1635	1	8	1671	1	25
1564		23	1600		39	1636		54	1672	1	10
1565	1	9	1601	1	25	1637	1	40	1673	1	56
1566		54	1602	1	10	1638	1	5	1674	1	41
1567		39	1603		55	1639	1	10	1675	1	26
1568		25	1604		40	1640		56	1676	1	12
1569	1	11	1605	1	26	1641	1	42	1677	1	58
1570		56	1606	1	11	1642	1	27	1678	1	33
1571		41	1607		56	1643	1	12	1679	1	28
1572		26	1608		32	3644		8	1680	1	13
1573	1	12	1609	1	28	1645	1	44	1681	R 2	0
1574		57	1610	1	13	1646	1	29	1682	1	45
1575		42	1611		58	1647	1	14	1683	1	30
1576		28	1612		44	1648	1	0	1684	1	15
1577	1	14	1313	1	30	1649	1	46	1685	2	2
1578		59	1614	1	15	1650	1	31	1686	1	4
1579		44	1615	1	10	1651	1	16	1687	2	32
1580		29	1616		46	1652	1	2	1688	1	8

This Table of the Equation of the Sunne, serueth from the yeere of. 1545. where it hath his roote or begynning, vntyl. 1680 and in the yeere of. 1681. it shal returne to the roote, adding therunto one degree more. As for example. In the yeere of 1681. adde one degree vpon the other degree that the roote hath, and so shal the yeere of. 1681. haue two degrees of Equation, and the yeere of. 1682. shal haue one degree, and. 45. minutes, whiche is to adde one degree vpon. 45. minuts, that had the yeere of. 1546. etc. And hauing passed other. 136. yeeres, you shal returne to the roote, addyng two degrees.

The. iii. Chapter, of the declination of the Sunne.

What is the declination of the Sunne.

THE declination of the Sunne, is the arcke of the greater circle, whiche passeth by the Poles of the worlde, included betweene the Equinoctiall and the Zodiacke. And here is to be noted, that whatsoeuer foure poyntes or pyckes which are equally distant from the pointes of Equinoxes (whiche are the begynnynges of Aries and Libra) shal haue equal declinations.

Whereof it followeth, that the foure quarters of the zodiacke haue equal declinations. And to auoyde prolixitie, I wyl adde hereunto a table of the declinations of onely one quarter of the zodiacke, so that al hauing one selfe same maner of declinations, it may serue for all, and the order of it is this. The signes whose declination increaseth, are in the head or fronte of the Table, and the degrees of these signes descend by ꝑ left side thereof. And the signes whose declination decreaseth, are in the foote of the table. and the degrees of these signes, ryse by the right side of the same. The disposition of the table beyng vnderstoode: then to knowe what declination the Sunne hath in euery degree of the zodiacke, you ought to know the true place of the Sunne (as in the

Chapter

Signes	♈	♎	♉	♏	♊	♐	Signes
♑	♑	♋	♑	♋	♑	♋	♑
0	0		11 30	20	12	30	
1	0	24	11 51	20	25	29	
2	0	48	12 12	20	37	28	
3	1	12	12 33	20	49	27	
4	1	36	12 53	21	0	26	
5	2	0	13 13	21	11	25	
6	2	23	13 33	21	22	24	
7	2	47	13 53	21	33	23	
8	3	11	14 13	21	42	22	
9	3	35	14 32	21	51	21	
0	3	58	14 51	22	0	20	
11	4	22	15 10	22	9	19	
12	4	46	15 28	22	17	18	
13	5	9	15 47	22	25	17	
14	5	32	16 5	22	32	16	
15	5	55	16 23	22	39	15	
16	6	19	16 40	22	46	14	
17	6	42	16 57	22	52	13	
18	7	5	17 14	23	57	12	
19	7	28	17 31	23	3	11	
20	7	50	17 47	23	8	10	
21	8	13	18 3	23	12	9	
22	8	35	18 19	23	15	8	
23	8	58	18 34	23	19	7	
24	9	20	18 49	23	22	6	
25	9	42	19 4	23	24	5	
26	10	4	19 18	23	26	4	
27	10	26	19 32	23	28	3	
28	10	47	19 46	23	29		
29	11	9	19 59	23	30	1	
30	11	30	20 12	23	30	0	
Signes	♌	♏	♒	♈	♎	♉	Signes

chapter passe is declared) for the day of the declination whiche you desyre to knowe, and the signe whiche the sunne shall be found in that day, shall you seeke in the fronte or foote of the table. And yf it be in the fronte, you shal seeke the number of the degrees on the leaft syde. And yf it shalbe at the foote of the table, you shall seek it on the ryght syde. Then aboue or vnder the signe, in the fronte of that degree of the sayd signe, you shall fynde two numbers, whereof the fyrst is of degrees, and the seconde of minutes: and those degrees and minutes of declination the Sunne hath that day. And this is vnderstood without hauing respecte to the odde minuts aboue the degree, which the true place of the Sunne hath.

And yf you desyre to verifie this more preciselye, note the declination of that

degree, and of the degree folowyng: and take the lesse from the more, and that which remayneth, shalbe the difference of the declination from the one degree to the other, of which difference ye shal take a parte proportionally, as are the minutes of the place of the sunne vnto. 60. And this parte of minutes must be added to the fyrst declination of it, and be lesse then the seconde, or must be taken from it yf it shalbe greater. and then that riseth thereof, shalbe the precise declination for that signe, degree, and minute. As for example. In the yeere. 1546. the tenthe day of September, the sunne shalbe in 26. G. 38. ♍. of Virgo, & to the 26. G. precise, shal correspond. 1 G. 36 ♍. of declinatiō. And to bestile the declination that commeth to. 38. minutes, whiche is more of the. 26. G. you must marke the difference that is from the declination of. 26 G. (whiche is one. G. 36. ♍.) to the declination of the 27. G. which is. 1. G 12 ♍ The difference is. 24. ♍. Of these you must take such part proportionally, as the. 38. minutes beareth vnto. 60. which are almost two terces of a degree. Then the two terces of. 24 are. 16. whiche must be taken from one degree. 36 ♍. which correspond to the 26. G of Virgo, because the declinations goe decreasyng, and remayneth. 1. G. 20. ♍ and yf the declinations increase, you must adde thereto, as you take away when they decrease.

An other example for this yeere of. 1561.

Example for the yeere. 1561. the. 20. of Aprill, I finde the true place of the sunne at noone. in. 9 degrees. 54. minutes of Taurus: then in the table of signes present, I seeke for the. 9. degree of Taurus, to which dooth answeare for the declination 14. degrees 32. minutes, & to ỳ next degree folowing, dooth answeare. 14 degrees 51. minutes: then take the lesser out of the more, so resteth. 19 minutes. Thē frame a rule of. 3. & say, if. 60. minutes geue. 54 minutes (which. 54. minuts doth rest before of ỳ. 9 degree of Taurus) how many doth. 19. minutes geue whiche. 19 minutes are ỳ diuersitie of ỳ. 9 & .10. degrees of Taurus. So I finde. that. 19 minutes geueth 17. minutes. & 6. secondes, which. 17. minutes, & .6. seconds, I adde to the. 14. degrees. 32. minutes, whiche answeareth to the. 9. degrees of Taurus.

And

And it commeth to fourteene degrees.49.minutes, and syxe seconds, which is the true declination for the twentie day of April Anno.1561.

It is also to be noted, that I adde these seuenteene minutes & syxe secondes, because the declination doth encrease: for if it decreased, it were to be taken out so much, & the rest is the declinaon. So is the declination for the twentie of April in the yeere 1561. fourteene degrees.49.minutes, and syxe secondes.

The.iiii.Chapter, of the entrance of the Sunne into the twelue signes. And of the Equinoctials and Solstitials which deuide the foure tymes of the yeere.

OF that is sayd in the chapter before, it foloweth that ẏ sunne entring into the foure principal signes, causeth the foure times of the yeere. For entryng into Aries, it chaungeth the time to vs from winter to the spring tyme. And entryng into Cancer, it chaungeth the tyme from spring to sommer. And entryng into Libra, frō sommer to Autumne. Likewise entryng into Capricorne, it chaungeth frō Autumne to wynter. So that whē to vs that be on the part of the North, is sommer, then is it wynter to them that are on the South parte. Or contrarywyse, beyng sommer to them on the South, it is wynter to them on the North. The entrance of the sunne into these signes, and al other of the zodiacke, hath not been euer at one selfe same tyme of the yeere The cause of this is, that the Latine yeere is not equal with the moouing of the sunne in the zodiacke, as shalbe sayd in the.x chapter, where we wyl entreate of the yeere. In the tyme that Christe our redeemer was borne, were the Equinoctialles. The one at the eyght of the kalendes of Aprill,

The entrance of the Sunne into the foure principal signes.

The latine yeere.

The Equinoctials in the yeere of Christes byrth.

and the other at fyue of the kalendes of October: So that they had the Equinoctial of the spring, at the .xxv. of Marche, and the Equinoctial of Autumne, at the .xxvii. of September, as writeth John Baptist Capuano vpon the second Chapter of the sphere of Iohan. de sacro bosco. They iudged then the Solsticials, as that of the sommer, at the eyght day of the kalendes of July, whiche is the .xxiii. of June, the other of the wynter, they iudged at the eyght day of the kalendes of Januarie, whiche is the .xxv. of December. And here wyll I not omit to say howe in those tymes, at these foure dayes (that is to meane, in the two Solsticialles and two Equinoctialles) were celebrated, or dyd chaunce foure marueylous thynges in the worlde. For in the spryng Equinoctial, which was at the .xxv. of March, the sunne of GOD was incarnate, and afterwarde borne of the Virgin Marie in the Solsticial of wynter, whiche was at the .xxv. of December. In the Equinoctial of Autumne, whiche was the xxvii. of September, was conceiued blessed John Baptist, the cryer and precursour of Christe: and was borne in the sommer Solsticiall, that was the .xxiiii. of June. And this is the syth moneth whereof saint Luke speaketh in the Gospell. Whiche thyng also John Chrisostome doth verifie, saying that Saint John was borne when the dayes beganne to decrease, and our Lord when they began to increase. And it may certaynely seeme woorthy to be had in memorie, that in the sayde Equinoctiall of the spryng, Christe suffered, Adam was created and loste the estate of innocencie, Abel was slayne, Melchisedech offered bread and wyne, Isahac by Abraham was brought to be sacrificed, Jhon Baptist was beheaded at Macherunta. Peter delyuered out of pryson, Saint Iames beheaded by Herode, the good theefe enioyed Paradise, and the bodyes of many Saintes rose with Christe. And who so further desyreth more precisely to knowe the entraunce of the Sunne into Aries, and into the other pryncipall signes, shall in the thyrde parte of this woorke in the eyght Chapter, fynde rules whiche shall bryng hym to the knowledge

The Solsticials.

Foure notable thynges.

To know more precisely the entraunce of the Sunne into the foure principal signes.

ledge thereof. But to returne to our tyme, I say that this present yeere of. 1545. the sunne entreth into the fyrst degree of Aries, at the tenth of March, at foure of the clocke at after noone, and into the fyrst degree of Taurus the nienth of Aprill. 2. houres, 7. minuts, & into Gemini the. 11. of May, 2. houres, and syxe minutes, into Cancer, the. 11. of June. 14. houres. 44. minutes, into Leo the. 13 of July. 3. houres. 50. minutes, into Virgo the. 13. of August. 9. houres. 56. minutes, into Libra, the 13. of September 4 houre. 4. minutes, into Scorpio, the. 13. of October. 7. houre. 13. minutes, into Sagittarie, the 12. of Nouember, iust at noone, into Capricorne, the. 11. of December. 8. houre. 16. minutes, into Aquarius, the. 9. of Januarie, 2. houres, one minute, into Pisces, the. 8. of Februarye. 1. houre. 30 minutes after myddaye (that is to say) from noone. 1. houre 30. minutes. And that we may in the yeeres to come, knowe the day, houre, and minute, in the whiche the sunne entreth into euery signe, we wyll folowe this order. Upon the dayes, houres, and minutes, that the sunne entreth into euery signe this sayde yeere. 1545. we must adde for euery yeere syue houres and. 49. minutes, whiche with the. 365. dayes, which euery yeere conteyneth, shalbe the tyme in the which the sunne accomplisheth his reuolution. And because that in the yeere of the Bisextile or leape yeere, is added to Februarie one day more to his. 28. which he hath once in foure yeeres, from. 6. to. 6. houres, yf we shal take from the computation that whiche we haue geuen hym, turnyng one day backward (as shalbe in the yeere. 1548.) and vpon that that remayneth shall returne in the yeere folowyng of. 1549. to adde syue houres. 49. minutes, and as muche more euery other yeere folowyng, shalbe a certayne rule for euer.

To knowe when the sunne entreth into euery of the. xii. signes.

Leape yeere.

And it is to note, that the degrees and minutes whiche we haue touched before, are properly for the citte of Cadiz. And yf we desyre to applye them for other Cities or places more Eastwarde: then for euery. xv.

degrees that they are distant from Cadiz in longitude, we must adde one houre. And yf for Cities, or places more Westwarde, in lyke maner for euery. xv. degrees we muste take away one houre, by reason of the course of the Sunne by his rapte mouing from the East to the west. For it is certayne, that when with vs in Cadiz it is. xii. houres of the clocke, to them that are xv. degrees Eastward from vs, it is one of the clocke, and to them that are from vs. xv degrees towarde the West, it is xi. of the clocke.

Variation of houres by the rapte mouing of the Sunne from East to West.

Now that we haue rules to knowe the enteraunce of the Sunne into the. xii. signes, thereby may we also knowe his enteraunce into the foure Cardinall or principall signes, whiche are they that determine and ende the Equinoctialles and Solstitialles, whereby are caused the foure tymes of the yeere. And forasmuche as the generall chaunge of tyme, is by reason of the Sunne, who by his commyng neare, warmeth, by his remaynyng, dryeth, with his departure, cooleth, and by his long tarlyng away, Causeth moystnesse, we wyl shew the qualities of the principall wyndes, elementes, regions, humours, and ages, in one briefe table: and then consequently in an other wyl we describe the beginnyng, middest, and ende of the foure tymes of the yeere, aswel in the monethes, as in the heauenly sygnes.

The entrance of the sunne into the. iiii. principal signes, causeth the chaunge of tyme.

The table of the qualities of the Elementes.

Qualities	Hot & dry	Hot & moyst	Cold & moist	Cold & dry
Partes of the yere	Sommer	Spryng.	Wynter.	Autumne
Principal wyndes	East	South.	West.	North.
Elementes.	Fyre.	Ayre.	Water.	Earth.
Regions.	East.	South.	West.	North.
4. Humours.	Choler.	Blood.	Fleame.	Melăcholy
4. Ages.	Youth.	Mans state.	Aged.	Age.

The

The Table of the foure tymes of the yeere.

Tymes.	Beginnyng.	Myddest.	Ende.
Sprynge	March. Aries.	Apryl. Taurus.	May. Gemini.
Sommer.	June. Cancer.	July. Leo.	August. Virgo.
Autumne.	Septemb. Libra.	Octob. Scorpio.	Nouemb. Sagit.
Wynter.	Decemb. Capricor	Januar. Aquar.	Febru. Pisces.

The. v. Chapter, of the moone, and of her motions and properties.

IN the Chapters past of this seconde part, we haue entreated of the sunne, and of his motions & effectes, as the most noble and principal luminarie. In this present Chapter we wyl entreate of the Moone, which is the seconde luminarie, although in the order of the heauens she is the fyrst, and nearest vnto vs of al other planets or starres. The Moone therefore is a round body, of heauenly substaunce, solide and darke in respecte of the Sunne, hauing no proper lyght of her owne, but is apte to receyue lyght. She is moued from the West into the East, according to the order of the signes. euery day. 13 degrees litle more or lesse, and some what more then. 10 minutes, by the proper motion of the heauen or sphere vpon the Axes and poles of the zodiache. I sayde more or lesse, because that ouer and beside the mouing of her deferent or circle, which is moued euery day ỳ aforesayd. 13. degrees and. 10. minutes, almost 11. she hath an Epicicle where the moone is fixed: at ỳ motion wherof, somtimes she is mooued more swiftly, & somtimes more slowly: Neuertheless, accordyng to her halfe motion, she maketh her course in. 27. dates & almost. 8. houres: and hauing no lyght of her owne, she is lightened of the sunne, as manifestly appeareth hereby, that beyng in coniunction with the Sunne, or neare vnto hym, we see her not lyghtened: because the lyght whiche she then receyueth, is onely by her vppermost or hyghest parte, whereby she directly beholdeth the Sunne, forasmuche as she is in

The sunne and moone are the principal luminaries.

The Epicicle of the moone

The coniunction of the moone with the sunne.

The moone receiueth her light of the sunne.

The aspect of the moone to the sunne.

in the fourth heauen, and she in the fyrst. And departing from the Sunne by her proper mouing, the sunne remayneth on the West part. Then towarde that part we begyn to see a litle of the part of the Moone lyghtened, and so more and more by litle & litle as she departeth further from the sunne. And at this tyme she hath her hornes or corners towarde the East, because the sunne is in the West. During this tyme also, she is sayd to increase, or that she goeth increasyng vnto the oppositiõ whiche we see, by the part of her, which ỹ sunne directly beholdeth. And so do we see her altogeather lyghtened, and cal it the ful Moone. Then passyng from the oppositiõ, she commeth nearer the sunne by litle and litle, beyng darkened and hyd from vs, and lyghtened onely by her hyghest part: and this tyme is called the decreasyng or wane of the Moone. Then also hath she her hornes towarde the West, because the sunne is in the East: and this vntyl she turne agayne in coniunction with the sunne, and that we see her not lyghtened at al.

The increasing and apposition of the moone.

The bygnes of the Moone.

The moone is lesse then the starres or other planets, except Mercury, and lesse then the earth. And yf any shal affirme the contrary, saying that it is written in the fyrst of Genesis, that God made two great lyghtes: the greatest to geue lyght to the day, and the lesse to lyghten the night (as Dauid also affirmeth:) To this I answeare, that the moone being nearest vnto ỹ earth, appeareth vnto vs greater then she shoulde do, yf she were further distant from vs. And although she be great of lyght (receyued as we haue sayde) and bygge of bodye, yet is she not great in respecte of the other starres. And therefore the wordes of Genesis aforesayd, may be vnderstode to be spoken in such maner and phrase as holy scripture often vseth, to humble and applye it selfe to the weakenes of our vnderstandyng, and grosenesse of our senses.

The Moone is nearest vnto the earth.

The. vi. Chapter. of the coniunctions and oppositions of the Sunne and the Moone.

The

The sunne and the Moone are mooued vnder the zodiacke with diuers motions. The Moone with a swifter motion then the sunne followeth him, ouertaketh hym, and goeth before him, vntyl she place her selfe in Diameter with him. And when she hath thus ouertaken hym, so that they are both in one selfe same degree of the Zodiacke, then is the coniunction. Then departyng from him, and beyng in equall degrees of the signes opposite accordyng to the Diameter, is the opposition. To know the tymes of these coniunctions and oppositions, is very profitable and necessary for Mariners. These tymes may be knowen in two maners. One way, by the Ephimerides or Almanackes, or other tables, or Lunarie instrumentes. And by these meanes is knowen precisely the day, houre, and minute of the coniunction and opposition. It may lykewyse be knowen by the rules of computation, whiche are the rules that are knowen by memorie, although not precisely, as by the bookes aforesaid. And here is to be vnderstoode, that from one coniunction to another, accordyng to the halfe mooninges of the Sunne and the Moone, there palleth. 29. dayes, twelue houres, and 44 minuts. And consequently from coniunction to opposition, and from opposition to coniunction, the halfe thereof, whiche is fourteene dayes, xvili. houres, and 22. minutes. To knowe these coniunctions by rules of computation, is presupposed to knowe the golden number, and by it, the concurrent or Epacte.

The motion of the Moone.

The coniunction.

The opposite.

To know the tymes of oppositions and coniunctions.

The golden number, is the number of nienteene yeeres. In whiche tyme, the coniunctions of the Sunne and the Moone make al theyr varieties in the tymes of euery yeere: So that yf the coniunction were the twelfth day of Marche in this yeere of 1545. from this yeere in the nienteene yeeres folowyng, whiche shalbe in the yeere of. 1564. the coniunction shall returne to be at the twelfth day of Marche. It was fyrste called the golden number by the Egyptians, who fyrste founde the vse thereof, and sent it to Rome wrytten in golden letters. To fynde

To knowe the golde number.

this

this number, it is needefull to knowe his rootes, which is this. *The rootes of the golden number.* In the yeere that Chriſte our Lorde and redeemer was borne (whereby we make this accompt) the golden number was the number of one, whiche was the yeere of the roote or begynnyng: and the fyrſt yeere of the byrth of Chriſte, was two of the golden number. So that ioynyng to the yeeres of our Lorde one of the roote or begynnyng, and from al take away the nienteene, then the reſt ſhalbe the golden number. And yf you deſyre to make computation by a nearer roote, take for the roote the yeere of 1500. when nientiene was the golden number, and in the yeere of. 1501. dyd begin one of the golden number, and ſo conſequently euer takyng away the nienetiene.

This preſent yeere of. 1545. we haue ſeuen of the golden number. And in the yeere of. 1546. we ſhall haue eyght. &c.

The concurrent. The golden number beyng knowen, it is neceſſary for this computation of the Moone to know the concurrent. The concurrent of euery yeere, is the number of the dayes paſſed of the coniunction of the Moone at the begynnyng of Marche. And theſe growe of the difference of the Solar yeere to the Lunar: *The Solar & Lunar yeeres.* As the Lunar yeere hath. 354. dayes, and the Solar yeere. 365. ſo hauing euery yeere eleuen dayes of difference, whiche are added euery yeere vntyl they come to the number of thyrtie, and paſſyng thyrtie, thoſe that do paſſe are of the concurrent.

To finde the number of the concurrent. The number of the concurrent of euery yeere, is founde in this maner.

And the better to beare it in memorie, you muſte imagine three places: and theſe commonly are aſſigned on the thumbe. As the fyrſt place at the roote of the thumbe, the ſeconde in the myddle ioynt thereof, and the thyrde and laſt, in the toppe of the thumbe. Then in the fyrſte place put tenne, in the ſeconde twentie, and in the thyrde thirtie. Then by the order of theſe places ſhalbe compted the golden number: As one in the fyrſt place, two in the ſeconde, and three in the thyrde, returnyng foure to the fyrſte place. &c. vntyll the golden number of that yeere for the whiche the concurrent is ſought. And the number of that place where the golden number endeth, muſte be ioyned with the number of the golden number: and that dooth

amount

amount thereof, shalbe the concurrent. So that it passe not. 30 But if it passe. 30. then that that is more then. 10. is the concurrent of that yeere.

And here is to be noted, that the yeeres of this computation of the moone, begin at the fyrst day of March, and last vntyl the last day of February, so that this present yeere of. 1545. by computation of the golden number, we haue seuen: whiche accompted by the sayde places, endeth in the fyrst, which is. 10. whiche also ioyned with the golden number of seuen, make. 17. and so muche is the concurrent of this present yeere.

Like wyse, this number of Epacte, or concurrent, is found in multiplying the golden number by. 11. & deuidyng the summe by. 30 then that remayneth, is the Epacte or concurrent. *Epacte.*

The concurrent being thus knowen, then to know the daies of the moone, it is necessary to knowe three numbers. The fyrst, is the concurrent. The second, the number of the moneth in whiche you are, begynnyng at March. The thyrde, the dayes passe of the same moneth. And ioynyng these three numbers, yf they come not to. 30. so many dayes olde is the moone. And if they be. 30. it is the coniunction. And yf they passe. 30. they also that passe, are the age of the moone. *To knowe the dayes or age of the moone.*

This is vnderstoode in the monethes that haue. 31. dayes, for in them that haue onely. 30 dayes the coniunction is at the 29. day, and they that passe of. 29 are the age of the moone. As for example. The fyrst day of August, of the concurrent. 17. of monethes from March. 6. and of dayes of the moneth. 1. make 24. and so much is the age of the moone.

An other example. The tenth of September, of concurrent 17. of monethes, seuen, of dayes, ten, whiche are in al. 34. And because that September hath onely. 30. dayes, we must take away. 29. of the. 34. and so reast fyue dayes, whiche are the age of the moone. And in lyke maner shal we geue to February. 29. dayes of the moone.

It foloweth, that the dayes of the moone beyng knowen, then vnreckonyng or disreckonyng backewarde. *To knowe the daye of the coniunction.*

we

we fynd for example. The .xx. of July, the moone hath .xii. dayes taken from the .xx. Remayneth .viii. Then the eyght day was the coniunction.

The day of the coniunction is lykewyse knowen by ioynyng the monethes (begynning in Marche) with the concurrent, and yf they come not to .30. then at so many dayes of that moneth as lacketh of .30. shalbe the coniunction.

Example.

In August .6. of the monethes, and .17. of the concurrent, are 23. whiche of .30. lacketh .7. Then at the seuenth day was the coniunction, and yf they passe .30. then takyng them that passe from the number of the dayes whiche the moneth had next before, and then that whiche remayneth, dooth shewe the day of the coniunction. Lyke as the moone of September of the yeere. 1546. we shall count the concurrent .28. of monethes .7. whiche are .35. Then takyng away the .5. from .30. and one whiche August hath, remayneth .26. and so the .26. of August. of the yeere to come of .1546. the moone shal make coniunction.

The .vii. Chapter, of the declaration and vse of an instrument, by the whiche is founde the place and declination of the Sunne, with the dayes and place of the Moone.

To knowe the place of the moone in the Zodiack, and what aspectes she hath with the sunne.

IN the seconde and thirde Chapter, I haue geuen rules to knowe the true place of the sunne, & his declination. In this Chapter I wyl describe an instrument, wherebp may be knowen the declinatiõ and place of the Sunne, and knowyng by the Chapter passe, the dayes of the Moone, shall also be knowen her place in the zodiacke, and howe muche of her is lyghtened, and what aspecte she hath with the Sunne.

The

This instrument is in square fourme, and hath by the syde 23. degrees and a halfe, of the whiche the. 23. and a halfe that descend from the myddest downewarde, is the declination of the South signes: and the other from the myddest vpwarde, are the declinations of the North signes. Within this quadrature is described a circle, by the circumference whereof, are the twelue signes and their degrees, ioyned to the circumference: and further within, is the number of them, and then their names. Yet further within this, is another circle, where are the twelue moneches, with their numbers and dayes.

The description of the instrument.

Then to the center of this circle, are annexed two rundels, wherof the greatest and lowest is called the rundell of the sunne. This hath an Index or shewer, in which is paynted the sunne, and in the circumference of it are the dayes of the age of the moone. In the other circle, in the circumference therof, is a round hole, representyng the moone: directly from the whiche, is another Index comming forth of the circumference of this rundel, in whiche rundel are al the aspectes whiche the moone maketh with the sunne.

Hauing described the instrument, let vs declare the vse therof, whiche is this.

The vse of the instrument to fynde the true place of the Sunne.

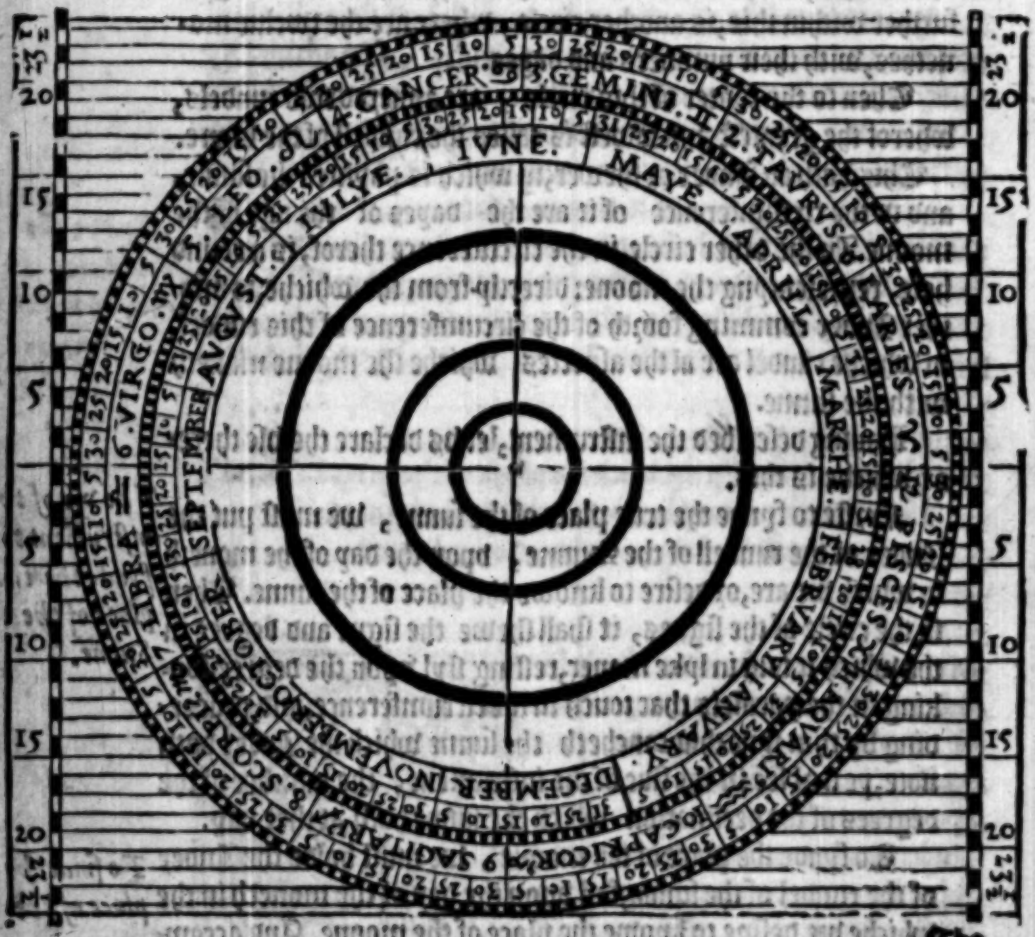
Fyrste to fynde the true place of the sunne, we must put the Index of the rundell of the Sunne, vpon the day of the moneth in which we are, or desire to knowe the place of the sunne. Then in the circle of the signes, it shall shewe the signe and degree in the which it is: & in lyke maner, resting styl vpon the degree looking in the paraleis that touch in the circumference, and proceeding by that lyne that toucheth the sunne which the Index doth note, ye shal see in the side of the instrument, the number of the degrees of the declination which the sunne hath at that day.

To finde the place of the moone.

To fynde the place of the moone, we must holde the Index of the rundel of the sunne, fast vpon the day of the moneth in the whiche we desyre to knowe the place of the moone. And accomptyng in the rundell of the sunne, the dayes that haue passed from the day of the coniunction (as I haue sayde in the Chapter before) and where endeth that number of the dayes, yt there

we

we apply the index of the Moone, it shall shewe in the circle of the signes, the place where she is. And so shal she appeare in the instrument lightened, or darkened more or lesse as in heauen. In lyke maner, conuiderynge the place of the Sunne & the Moone, shalbe seene, what aspect they haue, by the lines that trauerse the superficial of the Lunar circle or circle of the Moone.



The

The aſpectes which the planets haue one to another, or whereby they beholde one another, are fyue. *Fiue aſpectes of the planets.*

Coniunction, is when two planets be vnder one ſelfe ſame degree and minute in the Zodiacke, whoſe charact is this. ☌ *Coniunction.*

Oppoſition is, when betweene the place of the planettes is halfe a circle, which are, 180. degrees, and is thus figured. ☍ *Oppoſition.*

Trinall aſpecte is, when betweene the planettes ſhalbe foure ſignes, which are. 120. degrees, and is figured thus. △ *Trinall.*

Quadrine aſpecte is, when one planet is diſtaint from another by three ſignes, whiche are. 90. degrees, whoſe charact is this. □ *Quadrine.*

Sextile aſpect is, when two ſignes are betweene them which are threeſcore degrees, and is marked thus. * *Sextile.*

And yf by memorie you deſire to knowe the true place of the Sunne, without reſpect of the minutes (which may ſufficiently be doone with the Aſtrolabie) beare in memorie theſe numbers 10.9.10.11.12.13.14.13.14.13.12. Of the whiche the fyrſt ſerueth for Januarie, the ſeconde for Februarie, with theyr ſignes: and ſo of the reſt. Then to knowe in what degree the Sunne is, you ſhall take away the dayes that are applyed to euery moneth, according to the ſayde numbers of the dayes for the which you deſyre to knowe the true place of the Sunne, and in them that remayne, in ſo many degrees is the Sunne of the ſigne into the whiche it entreth that moneth. And yf the dayes paſt of the moneth, ſhalbe leſſe then the dayes applyed to the ſame moneth: you ſhal ioyne thirtie with thoſe dayes paſt of the moneth, & of the ſumme that amounteth, you ſhal take away the dayes applied to the ſayd moneth, and the reſt ſhalbe the degrees in whiche the Sunne ſhalbe of the ſigne of the moneth paſt, as for example. *To knowe the place of the Sunne by the rule of memorie.* *To knowe in what degree the Sunne is.*

C. i. Example.

Example.

Januarie.	10	♒	The.22.of October, takyng away foure-
Febyuarie.	9	♓	teene that were applyed, remayne eyght
Marche.	10	♈	degrees of Scorpie, where the Sunne is.
Apryll.	10	♉	Another example.
May.	11	♊	The syxth of December, whiche are lesser
June.	12	♋	then twelue whiche is applyed vnto it, yf
July.	13	♌	we ioyne syxe to thyrtie, whiche are the
Auguſt.	14	♍	dayes of the moneth next afore, they make
September.	13	♎	36. and from them we take away the.12.
October.	14	♏	reſt.24. So in.24.degrees, is the Sunne,
Nouember.	13	♐	of the ſigne of the moneth before, which is
December.	12	♑	Sagittarie.

The. viij. Chapter, of the Eclipſes of the Moone and the Sunne.

The Eclipſes of the Sunne & of the Moone, is a thyng that cauſeth great feare and admiration among the common and ignorant people, and to them that vnderſtande the cauſe thereof, nothing at all. And therefore haue I thought good to declare the effectes thereof.

The Eclipſe of the Moone.

The Eclipſe of the Moone, is the interpoſition or beyng of the earth betweene her and the Sunne. And whereas the Moone hath no proper light of her owne, and the earth, being darke and not tranſparent, maketh his ſhadow on the part oppoſite to the Sunne: the Moone by her proper motion doth paſſe by this ſhadowe, and is Eclipſed or darkened eyther in the whole or in part, accordyng to the portion of her that paſſeth by the ſhadowe. Moreouer (as we haue ſayd) that only the Sunne is moued in the lyne Eclipticke, and the earth beyng in the center of the worlde, the poynt or pricke of ꝑ ſhadow ſhalbe vnder the Eclipticke. The Moone declineth from the Eclipticke ſometimes to the one part, and ſometymes to the other, becauſe her eccentricke wherinto ſhe is moued, doth cut the Eclipticke equally into two halfes, ſo that the one halfe of the Eccentricke, dooth decline from the Eclipticke toward the North part, and the other

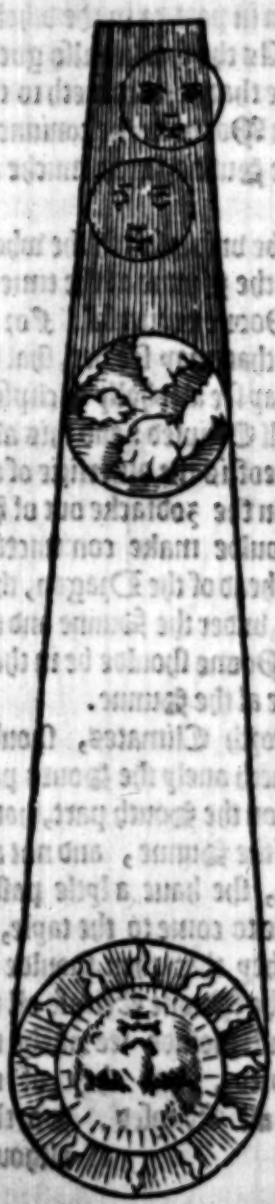
The mouyng of the Sunne in the Eclipſe.

halfe

halfe towarde the South, and the greatest declination of it from the Ecliptike, is.5.degrees. In that maner, the Moone shalbe at no tyme in the Eclipticke, but only when she shalbe in eyther of the interlections where the Eccentricke doth cut the said Ecliptycke. That interlection where she passeth & goeth toward the North part, is called the head of the Dragon, and is marked thus. ☊ The other where she passeth and decli-neth towarde the South part, is called the tayle of the Dragon, and is marked thus. ☋ And the Sunne moving by his proper mo-tion, and comming to the head, then shall the shadowe of the earth be in the tayle, because it is the poynt oppolite. And yf then the Moone come thyther, of her pro-per motion she passeth by the sha-dowe, and lackyng lyght of the Sunne, she is eclipsed. And yf the Sunne come to the tayle, the sha-dowe is in the head, and then like-wise shal the Moone be eclipsed, if she passe by the head.

The head of the Dragon.

The tayle of the Dragon.



It is to vnderstand, that ỳ sunne is much bigger then the earth, and by perspective, the shadowe of the earth in how muche the farther it parteth from it, becommeth shar-per and sharper, vntyl it come to a poynt: so that the shadowe of the whole earth, is piramidally sharp. And as the moone is lesse then the earth, yet (although his shadowe goeth sharpning) it suffiseth to e-clipse the Moone, if she passe by the myddest thereof.

The Sunne is bigger then the earth.

The shadowe of the earth.

The Eclipse of the Sunne.

The Eclipse of the Sunne, is the interpolition of the Moone betweene vs and the Sunne, as yf the Sunne be in the fourth heauen, and the Moone in the fyrſt, ſhe being a darke body, and by her proper motion ouertake the Sunne, then putting her ſelfe betweene him and vs, ſhe couereth him in part, or in the whole, and this is the Eclipſe of the Sunne. As the Sunne alſo goeth euer vnder the Ecliptyke, at the tyme that he commeth to the head or tayle of the Dragon, yf then the Moone make coniunction with him, ſhalbe the Eclipſe of the Sunne, for as muche as they are both vnder the Ecliptyke.

The Eclipse of the Sunne is not vniuerſall.

The Eclipſe of the Sunne can not be vniuerſall in the whole earth, I ſay, vnto all them that may ſee the Sunne at the time of the Eclipſe, as is the Eclipſe of the Moone vniuerſal. For yf the Moone haue one part Eclipſed, al that may ſee her, ſhal ſee her Eclipſed: But the Sunne ſome may ſee al wholly Eclipſed, and other in part, or other allo not at all Eclipſed: and this al at one ſelfe ſame tyme. The cauſe whereof, is the diuerſitie of the aſpecte, whiche is to ſee the Moone in the zodiacke out of her place: as yf the Sunne and Moone ſhoulde make coniunction in the beginning of Aries, and in the head of the Dragon, they that then ſhould be in the Equinoctial, vnder the Sunne and the Moone, or that the Sunne and the Moone ſhoulde be in theyr zenith, they ſhould ſee the Moone hyde al the Sunne.

Howe the Sunne is eclipſed in the whole, or in part.

And they that ſhoulde be in the Northe Climates, ſhoulde ſee, that the Moone hydeth or darkeneth onely the South part of the Sunne, and not al. Againe, they on the South part, ſhould ſee the Moone hyde the Northe part of the Sunne, and not all. And yf at the tyme of the coniunction, ſhe haue a lytle paſſed the head of the Dragon, or lacke a lytle to come to the tayle, ſo that ſhe be in the Northe latitude: they that then ſhoulde be in the Northe Climates, ſhoulde ſee the Moone Eclipſe all the Sunne: and they of the Equinoctiall ſhoulde ſee onely the Northe part of the Sunne Eclipſed, and they of the South ſhoulde ſee hym nothyng at all Eclipſed. So that although

although the Eclipſe of the Sunne ſhalbe totall or perticuler, it can not be vniuerſal in the whole earth.

And note, that for the quantitie of theſe Eclipſes, the Aſtronomers deuide into twelue equal partes, aſwel the Diameter of the Sunne, as of the Moone, and theſe partes they call fingers, punctes, or prickes, and accordyng to the punctes of the Diameter of the Moone, whiche is couered by the ſhadowe of the earth, or the partes of the Diameter of the Sunne, whiche the Moone doth couer, ſo many fingers or punctes ſhalbe ſayd to be Eclipſed. As pl. 6. the halfe, pl. 3. a quarter, pl. 4. a terce, or thyrde parte, pl. 6. three quarters, pl 8. two terces. *Of the quantitie of the Eclipſes.*

It is alſo to be noted, that although the Sunne be bygger then ỹ Moone, yet at ſome time the Moone ſeemeth greater then the Sunne. And this ſhalbe, when the Sunne is in the Auge of the Excentrike, & the Moone in the oppoſite of the Auge of the Epicicle. *Why the Moone ſeemeth ſomtime bygger, and ſometime leſſe then the Sunne.*

And when it ſo appeareth, he may be al Eclipſed. Sometimes alſo the Moone ſeemeth leſſe. This is when the Sunne is in the oppoſite of the Auge of the Excentricke, and the Moone in the Auge of the Epicicle. Then although we ſhould ſee the center of the Moone in the center of the Sunne, ſhe can not hide him al wholye, becauſe the Sunne ſhal appeare greater.

Of this that we haue ſayd, it folowyth that al the Eclipſes of the Sunne, muſt of neceſſitie be in the coniunction, and the Eclipſes of the Moone, in the oppoſition; wherebỹ is inferred, that the Eclipſe of the Sunne in *The Sunne is Eclipſed in coniunction, & the Moone in oppoſition.*

The Eclipse of the Sunne in the death of Christ.

the death of Christe our redeemer, was not naturall, but miraculous: forasmuche as then was .xv. dayes of the Moone, at whiche time the Moone is at the full, and farre distant from the Sunne, and coulde not Eclipse hym. In lyke maner is to be noted, that to see the Eclipses, they of the Sunne must be in the day, and they of the Moone in the nyght. And whether the coniunction be in the nyght, or the oppolition in the day, the Astronomers make none accompt.

Howe to see the Eclipses.

The.ix. Chapter, of tyme, and of the definitions thereof.

All moving is in tyme.

Forasmuch as hytherto we haue entreated of the mouinges of the sunne and of the Moone, and howe all mouing is in tyme (for that nothyng may be moued in any instant or out of tyme) it shalbe conuenient nowe to declare what thyng Tyme is, and into what partes it is deuided.

What is time.

Tyme (as sayth the Philosopher) is a measure of mouyng, accordyng to fyrst and last, or before and after. Although by accident (as Armandus hath subtilly defined) Tyme may be a measure of rest or quietnesse: as measures of habites, are measures of pymations. Or Tyme may be a measure of the mouyng of the fyrst moueable, called Primum mobile, and cause of generation thereby, and of corruption by accident. Tyme hath the limittes that hath the worlde, and as the worlde, so is it caused of the mouyng of the heauens, and began whan GOD created the heauens, and shall ende when the worlde shall haue an ende, as the holy Scholes of the Diuines teache vs. It is assigned to be within the heauens, forasmuche as without them, is neyther tyme nor any naturall place. All the tyme sence GOD creates the worlde, vntyll it shall haue an ende, is called Seculum. (that is) a worlde, or an age of Tyme. Albeit, this woorde

Howe tyme is cause of generation & corruption.

The beginning and ending of tyme.

The place of tyme.

Seculum

Seculum in an other sense, may be extended farther then the durabilitie or continuaunce of the worlde, and this in holy Scripture is called Seculum seculi, that is, the worlde of the worlde: or, Secula seculorum, whiche is as muche to meane, as the worlde and worldes to come, whiche signifieth, eternitie, or euerlastyng worlde without ende. Likewyse also, Seculum is taken for the space of a hundred yeeres, whereby in olde time certaine playes were called Seculares, because they were celebrate from a hundred, to a hundred yeeres. The Pope Paule, the thyrde of that name, commaunded them to be celebrate in Rome, in the yeere of. 1536. which was the yeere in the whiche the Seculum ended, and began a newe Seculum.

And as in tyme are diuers mouynges, so hath it diuers measures, whereof some are greater, and other lesse. The greatest measure of tyme, is a reuolution of the heauens, whiche is slowly mooued, and the principall or cheefe of these, is that that the Sunne maketh, whiche we cal a yeere. The lesse measure, is the mouyng of the fyrst mooueable, whiche mooueth most swiftly: and this measure we cal a day. And for as much as there is variation in the greatest measures, we wyll in the Chapter folowing, intreate of the yeere, and of the diuersitie thereof. *Diuers mouinges and measures of tyme.*

The. x. Chapter, of the yeere, and of the diuers beginninges and reckoninges, or computation had thereof in olde tyme.

THERE are three differences of the yeere, as the great yeere, called Annus magnus, the Solar yeere, and the Lunar yeere. The great yeere, is the space of time in the whiche all the Planetes returne to the place where they had been some tyme before. As yf they all had been in the beginning of Aries, and had begunne theyr course from thence, and shoulde agayne all returne thyther: then shoulde be the great yeere. *Three differences of yeeres. The great yeere.*

The reuolution of the right Sphere.

By the description of other, the great yeere is when the eight Sphere ioyntly with al the Auges, make one perfect reuolution at the mouyng of the nyenth Sphere. And this shalbe in the space of .xlix. thousande yeeres.

The Solar yeere.

The solar yeere, is a reuolution of the Sunne, carried by the proper mouyng of his heauen, vppon the Axis and Poles of the Zodiacke, endyng where it begaune, and renuyng an other yeere by the selfe same course, as the Poet Virgil affyrmeth, saying.

Atq; in se sua per vestigia volvitur Annus.

That is to say, The yeere turneth agayne to him selfe by his owne proper steppes.

How the Egyptians painted the yeere.

The Egyptians lackyng the vse of letters, and hauyng the same consyderation, paynted the yeere lyke vnto an Adder, byting her owne tayle: and hereof was a ryng called Annulus, as it were Annus (that is, a yeere) because a ryng turneth round in it selfe, as doth the yeere. Of the quantitie of this yeere were diuers opinions and computations among them of auncient tyme. The Arabians and Persians accompted it regularly by .xii. Moones, whiche are. 354. dayes. Romulus gaue to his yeere .x. moneths, because that time sufficeth to a woman to bring foorth her byrth, and also for that duryng so muche tyme, it was not lawfull for a Widdowe to marrie after the death of her husbande. Numa Pompilius added two monethes, to make it vp twelue monethes in. 350. dayes, whiche was the most auncient yeere of the Hebrues, accordyng to the whiche, they accompt at this day. The Grekes and Egyptians, consideryng the course of the Sunne, made the yeere of. 365. dayes. Then by the commaundement of Julius Caesar (whose order we nowe obserue) were added fyue houres, to the ende to make equall this number of dayes with the course of the Sunne: and hereof the Bissextile or Leape yeere had his beginning, from foure to foure yeeres. But to say the trueth, they erred: The one, by somwhat too much, and the other by somewhat too litle.

The yeere of the Hebrues.

The Grekes.

Iulius Caesar.

Leape yeare.

Dayes of the yeere.

This yeere conteyneth. 365. dayes. 5. houres, & .49. minutes.

Lyke

Lykewyse at the fyrst, the yeere had diuers begynnynges. Numa Pompilius beganne it from the Winter solsticiall, because that then the Sunne beginneth to ryse toward vs, as Ouid affirmeth in these verses.

Beginning of the yeere.

Ouid.

Bruma noui prima est, veterisq; nouissima Solis,
Principium capiunt Phœbus & Annus idem.

Bruma is the stay of the sunne in Winter, the Winter solstitial, and shortest day of the yeere.

VVhiche may thus be englyshed.

Brume is the fyrst of the newe yeere,
And last day of the olde:
The Sunne and yeere beginne at once,
As Ouid hath vs tolde.

Romulus began it at Marche, at the Equinox of the spring, because that then all thinges reuiue and floryshe: and by the opinion of the Diuines, it seemeth good reason to begyn the yeere at Marche, because the world was created the .25. of the Kalendes of Apryl, whiche is the .18. of the moneth aforesayde. Lykewyse, God speaking of this moneth to the people of Israel, sayd vnto them, This shalbe the fyrst of the monethes of the yeere. The Arabians begin from the Sommer solstitial, whose opinion is, that the Sunne was made in the signe of Leo. Other begin the yere in September, about the Equinoctial of Autumne, as do the Iewes, restyng in the aucthoritie of Genesis, where it is written thus: Let the earth bryng foorth greene hearbes, to haue fruite agreeabe to theyr kynde. &c. And because Autumne is a fruitefull tyme, they beganne from thence to accompt their yeere. The Grekes, Persians, and Egyptians, accompt it from October. The Christians, some from the Incarnation of Christe, other from his byrth, and other, from the fyrst day of Ianuarie.

The Creation of the worlde. Exod. xij.

Where the Christians begin the yeere.

In lyke manner, is great diuersitie in begynnyng the number of yeeres, whiche we call Era, that is, the date. The Grekes beganne their date, from the death of great Alexander. The Egyptians, from the death of Nabuchodonosor. The Persians,

Diuersitie in the number of the yeeres or the date.

sians from Gesdargit. The Arabians or Moores, from the preaching of Machomet, who was after the byrth of Christ. 626 yeeres. Other also from the Romane Emperours. The Christians began the accompt of our Sauiour Iesu Christ. 500. yeeres after his byrth, as writeth Cardinal Cusanus. And here it shall not be from my purpose, to shewe howe iustly and ryghtfully was commaunded by Don John Kyng of Spayne, the fyrst of that name, that in the Courtes and Parliamentes whiche he helde in Segouia, in the yeere of. 1383. leauyng the dates that they had begun from the Emperour Octauian, for tributes and other paymentes specified in Wrytynges and Priuiledges, they should no more put the date of the Emperour, for as much as the day in the which the sonne of God became man, and was borne by the blessed Virgin, was so excellent a thyng, and most woorthie to be had in memorie. So that in Spayne, since that tyme, in all common Writinges, the date is made from the Natiuitie of our Lorde, begynnyng there the fyrst day of the yeere, and commonly the fyrst day of January. Some Astronomers begyn it the fyrst of Marche.

Machomet.

The date of the Christians.

We haue in this Chapter entreated of the great yeere, and of the Solar yeere, with his quantitie, begynnyng, and date. In the Chapter folowyng, we wyll entreate of the Lunar yeere, whiche we call a moneth.

The. xj. Chapter, of the moneth, and of his differences.

The Lunar yeere, or moneth.

Reuolution of the Moone.

Consyderyng the moneth absolutely, without hauyng respecte to the Solar yeere, it maye be called a yeere, accordyng to the deuision we haue made in the Chapter of the yeere. For it is a reuolution of the heauen of the moone, which moueth slowly in comparison of the fyrst heauen. And yf we

we consyder the moneth as part of the yeere, then is the name of a moneth more proper vnto it. For this word Mens, mensis in Latin, is derived of Mensura, whiche signifieth measure. And so the moneth and yeere referred to tyme, all may be called moneth: forasmuch as all is the measure of tyme, as we haue touched in the sayd Chapter of the yeere.

The moneth is to be consydered in two maners: eyther (as it is) part of the Solar yeere, or is caused by the course of the Moone. The moneth that is parte of the Solar yeere, is that which at this day we vse. And into .xii. of these monethes, is the yeere deuided: as Januarie, Februarie, Marche, Aprill, May, June, July, August, September, October, Nouember, December. *The deuision of the yeere into twelue monethes.*

They are not al of equal dayes, Aprill, June, September, and Nouember, haue .30. dayes: all the other haue .31. except Februarie, whiche hath .28. and when the Bisextile or Leape is, it hath .29. The names and numbers of these monethes were assigned at the wyll and pleasure of men, and the cause why they haue remained so long time, is the auctoritie of the Emperours, that ordeined them for the common people, who accepted them by the Romane Church, which admitted the vse of them.

The Lunar moneth hath two consyderations. The one is the tyme whiche the Moone tarieth from that she commeth foorth from one point of the Zodiacke, vntyll she returne thyther by her proper mouyng, and this is called the moneth of the peragration, in whiche reuolution she spendeth .27. dayes, and almost .8. houres. The other consyderation is, hauyng respect to the tyme whiche the Moone tarieth, from that she is in coniunction with the Sunne, vntyll another coniunction. And this is called the moneth of Consecution, and is more then the moneth of Peragration, by two dayes .4. houres .44. minutes. For the Sunne and the Moone beyng in coniunction vnder one punt of the Zodiacke, and mouyng both by theyr proper mouynges, towarde the East, as the mouyng of the Moone is swyfter then the mouyng of the Sunne, she leaueth hym behynde. *The Lunar moneth.* *The moneth of peragration.* *The moneth of consecution.* *The mouyng of the Sunne and Moone in coniunction.*

And

And when she hath ended her moneth of peragration, she returneth to the poynt from whence she departed, and not findyng the Sunne there (because in the meane tyme the Sunne of his proper motion hath gone almost. 27. degrees) the Moone passeth from this poynt, and in the space. 2. dayes. 4. houres 44. minutes, ouertaketh the Sunne: and so commonly hath this moneth of consecution. 26. dayes. 12. houres, and. 44. minutes. So that whatsoeuer is sayd of the Lunar moneth, is to be vnderstoode of this moneth of consecution, whiche all they vse that account by Moones: as doo the Hebrues, Arabians, and Persians.

To knowe the tydes by the aspectes of the Moone.

The Mariners ought not to neclect this computation, because it is conuenient for them to knowe the tydes, and other effectes caused by the aspectes of the Sunne and the Moone, for their aspectes do correspond to the partes of this moneth, as the coniunction to the begynning, the oppolition to the middest, and the quartile aspecte to the quarter, and so of the other. Lykewyse in this moneth, is considered the illumination of the Moone, and the dayes that the lyght tayleth her: so that neyther by day nor by nyght we may see her, for beyng burnt vnder the beames of the Sunne. The tyme that she is so, is called Interlunium (that is) the chaunge of hyddyng, whiche is sometyme more, and sometyme lesse. When the coniunction shalbe from the begynnyng of Capricorne vntyll the ende of Gemini, and the Moone hath North latitude, and her mouyng swyfte: then shall the newe Moone soone be seene, and so shall the Interlunium be but lytle. And when the coniunction shalbe from the begynnyng of Cancer, vntyll the ende of Sagittarius, and the Moone hath South latitude, and her mouyng slowe, the longer wyll it be or the newe Moone shewe her selfe to vs, and certayne of these causes concurryng, and not all, so shall the Interlunium be in a meane betweene both.

The illumination or change of the Moone.

Interlunium, is the space of tyme in the which neither the old Moone doth appeare, nor the newe moone is seene.

The.xii. Chapter. Of the weeke.

THE weeke is a time of seuen dayes, the begynning whereof is Sunday, and so did the Iewes count their first day, saying, Prima Sabati. secunda Sabati. (that is) the first of the Sabboth, the second of the Sabboth. &c. to the sixth of the Sabboth, and then the Sabboth. The Romanes that called ỳ planets, Gods, for as much as the Sunne was principal among them, called their fyrst day, the day of the Sunne, the seconde, of the Moone, the thyrde, of Mars, the fourth, of Mercury, the fyfth, of Iubiter, the syxth, of Uenus, the seuenth, of Saturne. The Christians solemnising the Sunday, began their accompt from it: as, on such a day our Lorde was borne: or suche a day he rose: and on suche a day he sent the holy ghost vpon his Apostles. &c. They also accompt the dayes of the weeke for Ferias.

The weeke of the Iewes.

The Romans.

The Christians.

Ferine. signifieth vacant dayes, or some tyme holy or festinal dayes

The.xiij. Chapter, of the day, and of the nyght.

THE day is of two sortes, as, the naturall day, and the artificiall day. The naturall day, is the space of tyme, wherein the Sunne is caryed by the fyrst moueable about the earth, from the Meridian, to the Weast, and from the Weast vnder the earth, commyng to the East, and from thence returnyng agayne to the sayde Meridian: and this time hath the Equinoctiall geuen one whole turne, and more, suche part of it as correspondeth to the proper mouyng of the Sunne: or otherwise, the natural day is a circle discribed with the center of the Sunne, at the mouing of the first mouable. The Romanes began this natural day, from midnight, and ended it in the mydnyght folowyng, and so doo we accompt it for fastyng dayes: and

The naturall day.

The beginning of the natural day.

and from euenyng to euenyng, in celebratyng of festiuall dayes. The Athenienses began it at the Sunne set, or goyng downe of the Sunne. The Babylonians, at the rysyng of the Sunne. The Umbrians, and Ethuices, from the mydday, or noone, and ended it the noone day folowyng. In this manner doo the Astronomers begyn it, and fynde that the day shall euer begyn at one selfe same houre for the qualitie of the Meridians. And yf they had begunne it from the rising or fall of the Sunne, it should not be euer at one selfe same houre, because the Sunne riseth and falleth at sometymes sooner, & at other tymes later: and so should the begynning of the day be variable. And it is to vnderstande, that when we commonly say, at the tenth day of such a moneth: the same tenth day dooeth ende the same day at noone, and the houres that runne from that noonetyde forward, are of the eleuenth day: and so doo the Astronomers accompt them.

The ende of the naturall day.

The artificiall day.

The day artificiall, is part of the day natural, and is the time that the Sunne tarieth from that in riseth in the East, vntyll it fall in the Weast. And the nyght is that part that lacketh or fayleth for the naturall day, which is the time that the Sunne tarryeth from that he hideth hym selfe in the Weast, vntyl he returne to appeare in the East: and so the day artificiall and the nyght, make one naturall day. And accordyng hereunto, it is written in Genesis, that of euening and morning was made one day. Isodorus defining this artificial day, sayth, that the day is the presence of the Sunne, or the beyng of the Sunne aboue the earth: as it is night vnto vs when he is vnder it. Or otherwise, the nyght is the shadowe of the earth, extended diametrally oppolite to the Sunne. The quantitie and differences of these dayes artificiall, and theyr nyghtes, and howe they increase and diminyshe, we haue largely declared in the fyrst Chapter.

The nyght.

The

The. xiiij. Chapter. of houres.

AS there is two differences of the day, as the naturall day, and artificiall: so is there two differences of houres, as houres naturall, whiche corresponde to the natural day, and houres artificial, whiche correspond to the artificiall day. Hora or Ora is a Greeke name, and signifieth ende. And so say we Oro maris. for the ende or bynnme of the sea, or the list or edge of apparell, as sayth Isodore in his Etimologies. *Houres natural and artificiall.*

The houre natural or equal, is a. 24. part of the day natural, & is the tyme of passyng fyfteene degrees of the Equinoctial. These 24. houres that make one naturall day, the Astronomers dooth begyn the day at the Meridian, compting the houres after the order of the fyxt mooueable, which is from the sayd Meridian, proceedyng towarde the West, and from them to the Meridian in the angle of mydnyght, where they accompt twelue houres, and from thence towarde the East, and come to ende the. 24. houres in the same Meridian where they began: and this they vse for the computation of the tables of the mouinges of the heauens. The Astronomers vse the same in their instrumentes, as in the Astrolabie, and Dials Horizontal, and vertical, and in all other instrumentes for houres. In Spayne also we vse to accompt these. 24. in two tymes twelue, begynnyng at noone, and endyng twelue at mydnyght: and agayne, begynnyng at mydnyght, and endyng other twelue at noone. And to distinct the one from the other, they cal the one afternoone houres, and the other forenoone houres: and commonly we say fyre houres of the morning, & fyre of the euening. In Italie they accompt them from the fallyng of the Sunne, vntyl the next fall the day folowyng. *The houre natural or equal.*

The artificial or temperal houre, is a twelfth part of the day arcke, or the nyght arcke. *The houre artificiel or temperal.*

They

They are called temperall houres, because they varie in the tymes that the day varieth: For in the tyme that the dayes shal be great, so shalbe the houres: and when the dayes shalbe short, so lykewyse shal the houres be, and in like maner of the nightes. So that, as the artificiall day great or lytle, is deuided into twelue houres: euen so the nyght great or lytle, is deuided into other twelue. The auncientes deuide the day into foure partes, and the nyght into other foure, geuyng vnto euery quarter part three houres. At the rysyng of the Sunne, which was the fyrst houre of the fyrst quarter, they called the fyrst houre: and three houres passed, they called the third houre, and syxe houres passed of the day, they called the syxth houre, which was the mydday or noone tyde. Also the nienth houre, they named at niene houres past of the day. And the Sunne set, or goyng downe of the Sunne, they called the Euenyng: as sayth the Poet Virgil in this verse.

The day and nyght diuided into foure partes.

Ante diem clausam componet vesper olimpo.

Interpretation of certayne places of the Gospel.

And accordyng to this computation, is to be vnderstood that writeth Saint Matthewe: That the labourers came to the Vineparde at the eleuenth houre, whereby is meante the syxth houre, one houre before the Sunne was set. And when we reade in S. Iohn: The ague left hym the seuenth houre. &c. By this accompt it was one houre after noone, when Christe healed the sonne of the Ruler that was diseased in Capernaum. In lyke maner by these houres the auncientes deuided the nyght into foure quarters, geuyng three houres to euery quarter. And in these foure partes of the nyght were Souldiers appoynted to watche. In the fyrst quarter, whiche they call Canticinium (and we the fyrst sleepe) they watched all. In the second, whiche they called Intempestium, beyng the turne of mydnyght, the young men watched. In the third, which they called Gallicinij. of the crowyng of the Cockes, watched the Souldiers of middle age. In the fourth and last quarter, called Matutinum or Antilucanum (that is, the spryng of the day) the olde Souldiers watched. And thus is vnderstood the fyrst, the seconde, and thyrde watche,

The night deuided into .iiij. quarters.

Foure watches of the nyght.

watche of the nyght, in like manner ought the Mariners to kepe watche and warde, to auoyde aswel the peryl of the sea, as also the daungers of Rouers: and to deuide the nyght by quarters, after the manner of souldiers, as vsed also the maryners in olde tyme. *Howe Mariners ought to watche.*

The .xv. Chapter, of the making and vse of an vniuersal Dyal for the day.

Whereas in the Chapter before, we haue intreated of houres, and theyr differences, we entende here to describe the makyng of an instrument general, to knowe the houres of the day by the beames of the sunne, whiche is done in this manner. Take a rounde plate of loton, & let it be called the Equinoctial circle, the circumference whereof, you shal deuide into .24. equall partes by both the sydes, and from the center to euery of these partes, you shall drawe a ryght lyne: one of the whiche shalbe a Meridian. And in the one parte of that, wryte twelue, whiche shalbe the houre of the midday or Noone. And in the other parte, wryte other twelue, whiche shalbe for mydnight. In the highest parte, turnyng vpon the center, towarde the ryght hande, wryte, one, two, three, foure, &c. In the lower, or neather parte, you shall counte towarde the left hande, turnyng it vpon the center: so that the one houre of the one parte, come vppon the lyne of the one houre of the other parte, in lyke manner two vpon two, three vppon three, and so forth of the other. And note that in the line of fire at after Noone, and at the lyne of fyre in the mornyng, there remayne certayne rounde peeces, corners, or endes, after the manner of axis, of the thycknesse of the selfe same plate. Then make a halfe circle of the same mettall, as bygge as the halfe circumference of the plate, and of the thyknesse of a peece of foure ryalles of plate, or somewhat *To knowe the houres of the day by the sunne.*

more, euen as the plate it selfe, and of the breadth of halfe a fynger, if the instrument shalbe greate: or lesse, if the instrument shalbe lesse. This halfe circle, shal you graduate or deuide into 180. degrees, begynnyng at the one ende, one, two, three, and so forth, vnto 90. in the myddest, and the lyke shal you doo from the other ende vnto ẏ same. 90. Also you must number them in ẏ breadth of the same halfe circle: & this halfe circle, shal you make fast on the neather parte of the instrumẽt, so that the ends therof may be fyxed in the endes of the Meridian lyne. Then through the center of the plate or Equinoctial circle, shal passe a rounde steele or wyre of the same mettal, made fast or soldered in it, so that it ryse and come forth equally from euery side of the plate the fourth part of the Diameter of the same, & this shalbe called the Axis or exiltree of the worlde. The instrument beyng thus made, you shal place it, or set it in a frame, hauing two armes, standardes, or arches, so that it change betwene the sayd arches, borne vp by the rounde peeces or endes of the plate, left thereof at the endes of the lyne of the fyre houres aforesayd, in such sort, that beyng thus stayed, it may be directly turned. And in the myddest betwene these two armes, beneath in the foote of them, or where they are placed, you shal raise a pricke, or poynt: so that the plate whiche signifieth the Equinoctial, beyng perpendiculer, the brymme or edge therof may fal vpon the point or pricke, and consequently the plate standyng playne or flat, the nintie degrees of the halfe circle, must shew or touche the sayde pricke, as shal also the ende or extremitie of the Axis of the worlde, and the other ende shal shewe the Zenith or vertical poynt.

The plasing of the instrumẽt.

This instrument must be so placed, that the Meridian line be North and South: which you shal fynde in this manner. In an open and playne place, where the Sunne shyneth for the moste parte of the day, you shall make a circle with a payre of compasses, in the middes whereof, you shall set a steele or wyre, so vpryght, that it decline not, or bend not, eyther one way or other, and the same no longer then the fourth parte of the Diameter of the circle. Then in the mornyng when the Sunne ryseth, the

The findyng of the meridian line.

shadowe

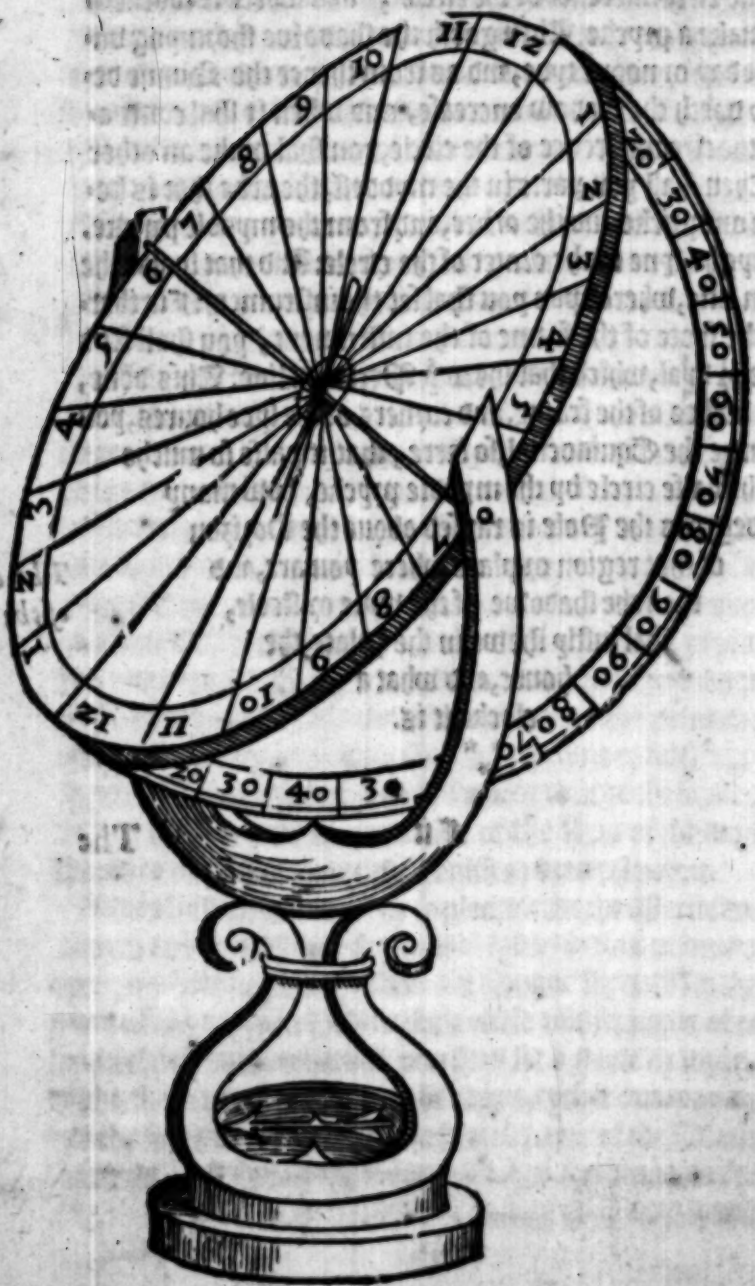
shadowe shalbe very long, and as it ryseth hygher and hygher, so the shadowe waxeth shorter and shorter. Then must you obserue the tyme, when the extremitie or ende of the shadow toucheth in the circumference of the circle, and where it toucheth you shal make a pricke. Then goeth the shadowe shortning vnto the myddaye or noone tyde, and as from thence the Sunne declyneth, so doeth the shadow encrease, and when it shal come agayne to the circumference of the circle, you shal make an other pricke. Then shall you parte in the myddest, the arke that is betweene the one pricke and the other, and from the myddle pricke, drawe a ryght lyne to the center of the circle: And that shalbe the Meridian line, whereupon you shal set the instrument. Furthermore, in the foote of the frame of the instrument, you shall set a compasse or ouall, which shal shew ỹ Meridian line. This done, vpon the arches of the frame, and corners of the syxe houres, you shal turne the Equinoctial, so farre, that it passe so muche of the halfe circle by the myddle pricke, how many degrees the Pole is rayled aboue the Horizon of that region or place where you are, and then the shadowe of the wyre or steele, shal iustly shewe in the Place, the houre, and what a clocke it is.

The elevation of the Pole.

* * *

If it The

Here foloweth the figure of the Instrument.



The.xvi. Chapter, of certayne particuler Dials, Mural and Horizontall.

AMong sundry maner and fashions of particuler Dials, there are two principal. Whereof the one is Horizontal, which is placed in the superficiall of the Horizon: the other is vertical, and must be made or set on a wall perpendicular, and directly against the South or midday, from the true leuant or East, to the true ponent or West, the which the Mariners call East and West. *Dyals Horizontal and verticall.* *East & West.*

To make any of these two Dials, you must drawe a right lyne, and call it the Axis of the poles of the worlde, vpon the whiche you shal drawe an halfe circle, and deuide it in 90. equall partes. And where the halfe circle is cut with the lyne of the Axis, must be accompted by the circumference, the altitude of the pole for the citie or place for the whiche you intende to make the Dyal. And in the poynt of the circumference where endeth the altitude of the pole, you shall make a marke, and write there. The altitude of the pole. And from that poynt drawe a right lyne vnto the poynt where you began to accompte the altitude of the pole, whiche lyne shalbe called the Semidiameter, or halfe Diameter of the vertical circle. And from the same poynt of the altitude of the pole, drawe another right lyne to the other extremitie or ende of the Axis, and this shalbe called the Semidiameter of the Horizon: and lykewyse from the same poynt of the altitude of the pole, drawe a right lyne perpendiculer vntyll it touche in the Axis, and this shalbe called the Semidiameter of the Equinoctial. Hereby is considered a Triangle, whiche hath by the sydes thereof the Semidiameter of the vertical, the Semidiameter of the Horizon, and the Axis of the worlde, whiche Triangle shal serue afterwarde. These three Semidiameters, of the vertical, the Equinoctiall, and the Horizon, beyng founde, you shall make the Dyal in this maner. *The triangle.*

The making of the Dyall.

Drawe a ryght lyne somwhat long, and call it the lyne of contingence. This shal you cut with an other lyne in ryght angles, after the maner of a crosse, whiche shalbe the Meridian lyne. Then with your compasse, take from the Triangle the Semidiameter of the Equinoctiall, and of this bygnesse drawe a circle vpon the Meridian lyne: so that the edge or brymme of the circle, touche in the lyne of contingence. Then with a compasse, take the Diameter of the verticall circle, yf you wyl make a murall Dyal, or the Semediameter of the Horizon, yf you wyl make a Horizontal Dyal, on a playne or flatte fourme. Therefore with suche Semediameter as you desyre, you shall drawe a circle vpon the other part of the Meridian lyne, so that the circumference thereof touche in the lyne of contyngence. Then shal you deuide the Equinoctial circle into foure equall partes, and the quarter that is towarde the lyne of contingence, shal you deuide into syxe equal partes. And settyng the ende of the ruler in the center of the Equinoctial, and vpon euery poynt of them that deuide the syxe equal partes, from thence shall you drawe certayne ryght lynes, vntyll they touche in the lyne of contingence. And from these poyntes of the lyne of contingence, you shal drawe other ryght lynes, to the center of the Horizontal circle, whiche lynes shalbe the determiners of the houres. And neare vnto the Meridian lyne, where it toucheth in the lyne of contingence, you shal wryte twelue, and consequently towarde the East, you shal wryte, one, two, three, foure, fyue, syxe: and from the syxth houre, you shal drawe a ryght lyne, whiche shall passe by the center of the Horizontal circle equally distaunt from the lyne of contyngence. The one quarter of the Horizontal beyng drawen by the selfe same, and of the same measure and bygnesse shal you drawe the other, in suche sort, that the same bygnesse that is from twelue to one, the selfe same shal you geue from the twelfth, to the eleuenth: and the same bygnesse and measure that is from one and two, shal you geue from eleuen to twelue, and so forth of the other.

And note that the Horizontal Dyal, after the syxth houre of the euenyng, shall haue the houres of seuen and eyght, and

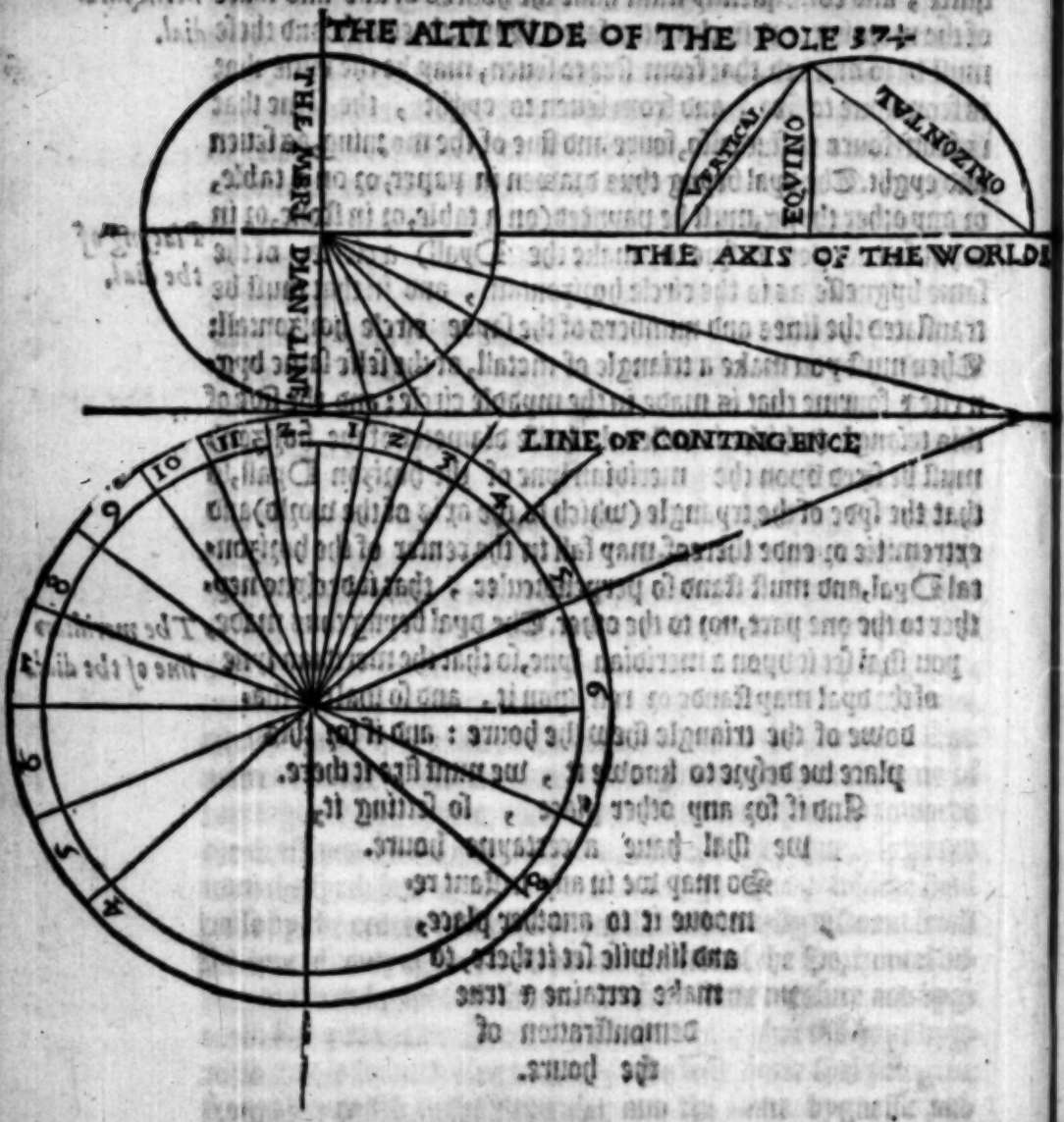
and in climates farre North.xi also, and more yf needs shall require, and consequently must haue the houres of fiue and foure of the morning, and in climates farre North, three also: and these must be so marked, that from sixe to seuen, may be the same that is from fyue to sixe, and from seuen to eyght, the same that is from foure to fiue: also, foure and fiue of the morning, as seuen and eyght. The dyal beyng thus drawen in paper, or on a table, or any other thyng, must be paynted (on a table, or in stone, or in what so euer you desyre to make the Dyall) a circle, of the same bygnesse as is the circle horizontall, and in that must be translated the lines and numbers of the sayde circle horizontall: Then must you make a triangle of metall, of the selfe same bygnesse & fourme that is made in the myddle circle: and the side of this triangle (whiche is called the halfe diameter of the horizon) must be fixed vpon the meridian lyne of the horizon Dyall, so that the syde of the tryangle (which is the axis of the world) and extremitie or ende thereof, may fall in the center of the horizontal Dyal, and must stand so perpendiculer, that it declyne neyther to the one part, nor to the other. The dyal beyng thus made, you shal set it vpon a meridian lyne, so that the meridian lyne of the dyal may stande or rest vpon it, and so shal the shadowe of the triangle shew the houre: and if for this place we desyre to knowe it, we must fixe it there. And if for any other place, so setting it, we shal haue a certayne houre. So may we in any instant remooue it to another place, and likwise set it there, to make certaine & true demonstration of the houre.

Houres of the horizontal dial.

Placyng of the dial.

The meridian line of the dial.

Here folowech the figure of this demonstration.



The makyng of the verticall dyall.

In lyke maner as is made the Horizontal dial, must be made the vertical, takyng from the triangle the Semidiameter of the Circle vertical.

And note, that for the Circle verticall, it shall not be neede

ful of more then sixe houres before noone, and other sixe after noone. And the triangle must be fixt in the meridian lyne vpon the side that is called the Semidiameter of the Circle verticall. And yf you wyll not make a triangle of metal, but that a wyre of Iron may geue the shadowe, then must you make the sayd triangle of past or paper. And according vnto the forme or paterne thereof make the wyre of Iron, and cause the same to be set in al sortes of dials, as is before sayde.

The .xvii. Chapter, of the composition and vse of an instrument general for the houres of the nyght.

Where as in the Chapters past, I haue described the manner and forme to make two dials for the houres of the day, me semeth that for the more perfection of this woorke, it would be conuenient here to teach the making of a dyal to knowe the houres of the nyght, by the Circle whiche the two starres, called the Guardians, or the mouth of the horne, doo describe by the mouyng of the firste moueable. But for as muche as it is a common opinion, that in the myddest of Appyl it is mydnyght when the Guardes be in the head, whereof they take the begynnyng of the yeere, I wyll declare how it ought to be vnderstoode. Certayne it is, that to be mydnyght, is noone other thyng but the sunne to be by the mouyng of the fyrste moueable, to euery one in that parte of his Merydian that is to hym vnder the earth, euen as is to hym myddaye, or noone, when to hym it is in that parte of the Merydian that is aboue the earth. And in this present yeere of. 1545. (to be out of doubt hereof) I made experience with a precise Astrolabie, so that the fyrst or forenoste Guarde starre, beyng perpendicularly ouer or aboue the North starre, I founde in the meridian, where the sunne marketh mydnyght, the 1. degree of Taurus, whereby it followeth, that the sunne being in this degree, which is at the .xix. of Appyl, the same Guarde starre shalbe perpendicularly ouer the

The Guarde starres.

What is mydnyght.

Noone or mydday.

the North starre, whiche is the lyne of the head, and consequently the sunne beyng in the nienth degree of Scorpio, which is at the.xxii. of October, the guarde starre shalbe in the lyne of the feete: and by this calculation may be knowen when it shalbe in the ryght or in the leafte, and in all the other lynes: so that they manyfestly erre, that accompt the mydnyght at the. xv. of Apryll, when the first guard starre is in the lyne of the head, accompting a terce or thirde parte of an houre sooner and more then they should doo.

An errour.

The making of the instrument.

Hauing thus geuen pryncyples for the instrument, you shall proceede in the makyng thereof, as foloweth. In paste, or on a plate of laton, make a circle of the quantitie of a spanne, or of the bignesse that you desyre the instrument or dyal to be: then make an other circle somwhat lesse, so farre distaunt from the greater, that betweene the one and the other may be a space, in the which may be signed or marked the dayes and monethes. Likewyse shal you make another lesse circle, leauing space to set the numbers of the dayes of euery moneth. And vnder this circle, shall you make another, leauing space to wryte the names of the monethes: then shall you deuide the first and greatest circle into eyght equal partes, so that the.xix. of Apryl may be in the highest or vppermoste parte of the instrument, whiche is where they say the lyne of the head to be, and the. xxii. of October must be in the neather parte. Also, the.xiii. of Januarie, in the ryght arme: and in the leaft arme, the.xvii. of July: and so the other dayes that doo fall to the other lynes, accordyng as they answeare to the ryght assension of the sunne, as you may see in this figure.

This being thus diuided, you must also diuide the spaces that are betweene the one lyne and the other, into the dayes whiche be numbred in euery space: so that betweene the. xix. of Apryll, and the thirde of June, are. 45. dayes, and that space shal you deuide into. 45. partes. And whereas the instrument beyng small, it can not in so litle space receyue so many partes, you shal deuide it from fyue, to fyue partes, and so shal you deuide the other spaces by the numbers that are signed in them.

Then

Then one day moze before the .x. towarde the left hand, you shal make a strike, and there shalbe the .xx. of Appl. And fyue dayes moze before, make another stryke, and there shalbe the .xxv. And yet other fyue dayes moze before, whiche shalbe the .xxx. of Appl, make another strike ouerthwart vnto the neathermost circle, and there shal May begyn. And from these dayes shall you begyn to accompt the dayes of May from fyue to fyue. And in the last spare you shal put syxe, whiche shal make the .xxxi. dayes that May hath.

And

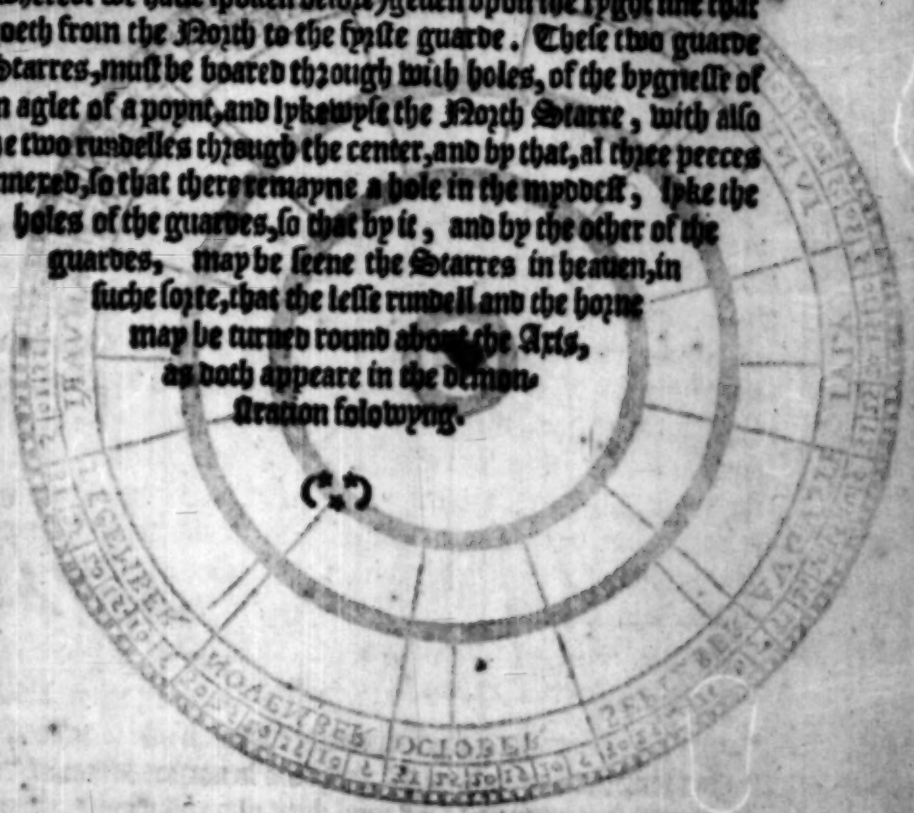
And there shall you make another strike, whiche shal traverse or ouerthwart vnto the lesse circle. And in this maner you shal deuide the other monethes, geuing to euery of them the number of his dayes.

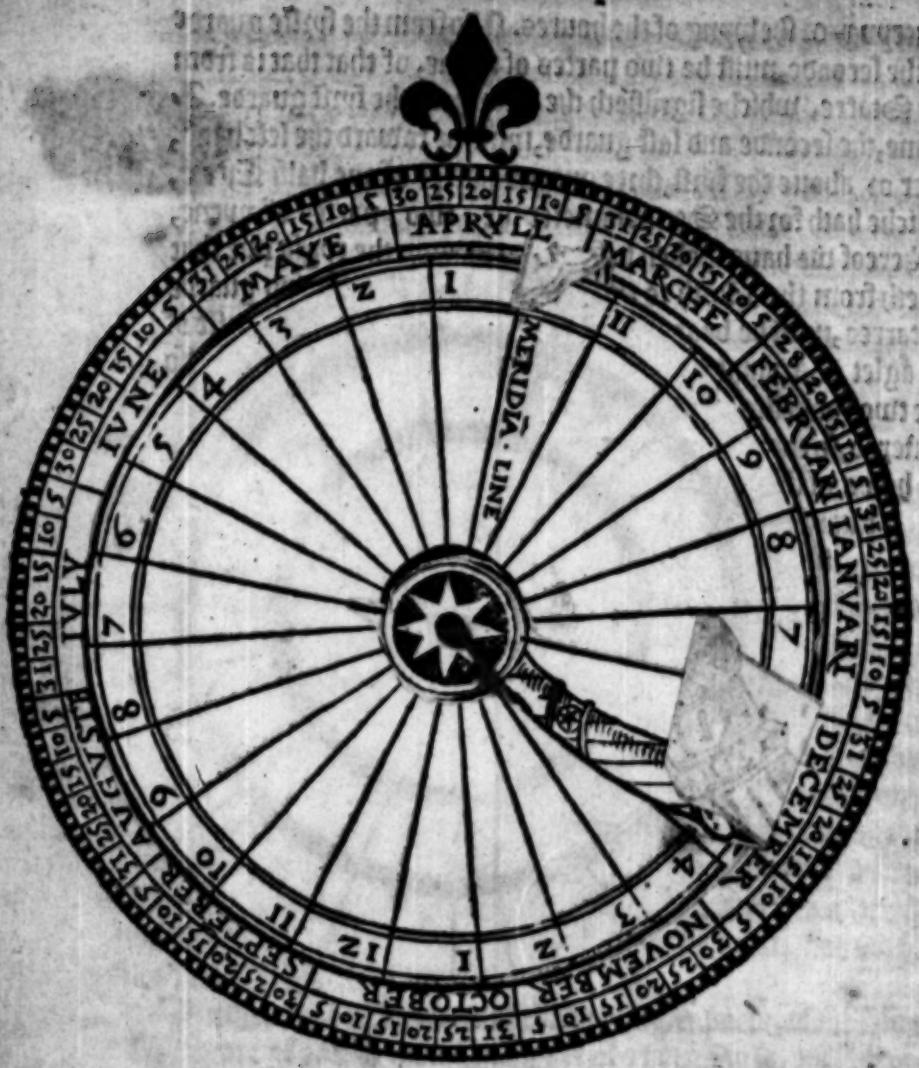
This beyng done, vpon the outward part of the great circle, you shal cut downe the paper, paste, or plate of laton, leauing of the same for a signe or marke a floure Deluce vpon the.xix. of Appyl, for that it must be the head: and lykewyse at the.xxii. of October, may be left a handel to holde it by Then must you make a rundel to the same paste or laton, of the bygnesse of the lesse circle, without the circumference whereof, shalbe left a toothe or index, in the which you shal wryte, Tyme. And from the one syde of this index towardes the left hand, you shal draw a ryght lyne, that may passe through the center to the circumference, & this shalbe the Meridian lyne. Also to this rundel you shal geue a circle, so muche lower from the circumference, that there may be left a space where the number of the dayes may be wrytten. And this rundel you shal deuide into.24. equall partes, begynnyng at the Meridian lyne of the index at the twelfth houre of the nyght. Then in the nert space towarde the left hand, you shal make the number of one. Likewyse in the second space the number of two, in the thirde, the number of three, and so forth of the residue, vnto the other twelue of the day, in the opposite or contrary parte of the index. So consequutiuely proceedyng .i. .ii. .iii. &c. vnto the twelue of the index, whiche shalbe the.xxiiii. houres of the natural day.

The borne of the seuen starres, whiche make the lesse beare.

Furthermore also you must make another peece, of the same substaunce of past or metal, in maner of a borne, in forme and order as are inbatten the seuen starres, whiche make the lesse beare: And this of such quantitie, that the first or formost guarde starre, may reache without the great rundell close to the circumference thereof, hauing the North starre his center, with the center of the instrument. And from this starre or center, vnto the fyrst and formost guard starre, must be a ryght lyne, by the whiche the borne must be cut neare from the center, vnto the discouering

couerynge or the wyng of the houres. Also from the fyrste guarde to the seconde, must be two partes of nyene, of that that is from the Starre, whiche signifieth the North, to the fyrst guarde. Againe, the seconde and last guarde, must be toward the left hand, ouer or aboue the fyrst, three quarter partes of one halfe Circle, whiche hath for the Semidiameter the two partes of nyene, (whereof we haue spoken before) geuen vpon the ryght line that goeth from the North to the fyrste guarde. These two guarde Starres, must be boared through with holes, of the bygnesse of an aglet of a poynt, and lykewyse the North Starre, with also the two rundelles through the center, and by that, al three peeces annexed, so that there remayne a hole in the myddest, lyke the holes of the guardes, so that by it, and by the other of the guardes, may be seene the Starres in heauen, in suche sorte, that the lesse rundell and the horne may be turned round about the Arts, as doth appeare in the demonstration folowyng.





To fynde the houre with the instrument.

The instrument thus ended, & brought to perfection, when you desire to know the houre, you shal turne the index of the lesse rundel in the whiche is written, Time, to that part of the greate rundell where is marked the day in the whiche you desyre to knowe the houre: & directyng your face toward the North, you shal make the head towarde the height of heauen, at the. 19. of

Apryl

Aprill. And seeyng in heauen by the hole in the myddest the starre of the Nozth, holdyng the instrument in suche compasse of the face, that by the circumference of the greater rundel, may be seene the Guarde starre in heauen, you shal turne the hoyne rounde about, vntyl it fall vpon the Guardes: so that by the two holes of the mouth of the hoyne, the two Guard starres may be seene, and by the hole in the myddest, the Nozth starre, and al thzee with one eye: then the ryght line that goeth from the Nozth to the first Guarde, shal shewe in the lesse rundell, the houre that shalbe.

The. xviii. Chapter, of the tyme of tydes, or ryssing and fallyng of the sea.

GReate accompte ought Pilots and Mariners to haue of the tydes, to take pozt, enter vppon barres, passe by flattes, and finally, foz al manner of nauigations. Foz beyng ignozant hereof, greate hurt and inconuenience myght chaunce vnto them, as did of late to the valiaunt captayne, Don Iohn Gusman the Earle of Niebla, in the peere of. 1436. who was dzowned before the citie Gribraltar, foz that the Mariners kept none accompt, neyther had consideration of the tydes. By reason whereof, not only he was dzowned, but also with hym dyed many woozthy gentlemen, and valiaunt captaynes of Spayne.

The Mariners opinion of ebbing and flowing of the sea, or tydes.

The mariners hold foz a certayne rule, that the moone beyng in the Noztheast, oz in the Southwest, is full sea: and beyng in the Southwest, oz Nozthwest, to be lowe water. They affirme also, that at the fyrst day of the newe moone, the sunne beyng at Nozthest, and a quarter to the East (that is Nozthest, and by East) the moone shalbe Nozthest, and then shalbe ful sea, and thzee houres, and thzee quarters.

Obseruation of the Moone to know the tides

And

And at the seconde day of the Moone, when the Sunne shalbe at East Northeast, the Moone shalbe at Northeast, and then shalbe full sea and foure houres, and two quarters, &c. Theyr accompt is, that the Sunne beyng in the North, is mydnyght: and beyng in the Northeast, they accompt three: and in the East, syxe. So that they accompt, three houres from wynde to wynde, by the eyght principall wyndes, or lynes, whiche the Spanyardes call Rumbos. These wyndes muste be imagined vpon the North, placed in the Angle, vnder, or beneath the earth: and the sunne and the Moone at the mooving of the fyxte moueable, and they ought not to be imagined in the Horizon, as the compasse sheweth. For speakyng by the tearmes of Astronomie, you muste vnderstande, that the Moone touchyng in the circle of houres at the number of three, is euer full sea: and touchyng in the same circle at the number of niene, is euer lowe water. No lesse ought they to obserue iuste accompt of the houres, by quarters of houres. For to geue. 30. dayes to the Moone, it shalbe necessary to accompt by the fyftes of houres, as shalbe sayde hereafter.

Eyght principall wyndes.

Here is to be noted, that the Spanyardes thynke (be lyke) that a Northeast and Southweast Moone, maketh a full Sea in al other places, as it dooth in Spayne. But in that they be greatly deceyued, and therefore the rule that they haue set foorth for the tydes, serueth onely for suche places where it floweth Northeast and Southweast Moone a full sea.

The Moone causeth the ebbing & flowyng of the Ocean Sea.

And the better to vnderstande the increasyng and decreasing of the Ocean Sea, it shalbe conuenient to knowe the cause thereof, whereunto we say, that the Moone is the cause of ebbyng & flowyng, or rising and fallyng, increase or decrease of the sea: not onely by her lyght, but also by her secrete or hyd propertie. The Moone compasseth about the earth, from the East into the West, vntyl she returne to the place or poynte from whence she departed: and in this course wasteth or spendeth so muche more then one natural day, in howe muche her proper mooving is more then the sunne agaynst the fyxte moue-

The monyn, of the moon.

able

able, so that she maketh her turne or course about the foure quarters of heauen in .xxiiii. houres, and foure fythes of one houre, whiche are the twelue degrees that she goeth more then the Sunne. And in this time the Ocean increaseth and decreaseth twyse, so that this increasing and decreasing, answereth directly to the course of the Moone: whereby it followeth, that the sea increaseth syxe houres and one fyfth part, and decreaseth other syxe houres, and one fyfth. And yf this day at the twelfth houre, was full sea, the lowe water shalbe at the syxth houre and one fyfth part: and at the twelfth houre and two fyfth partes it shal returne to be full sea: and at the syxth houre and three fythes, shalbe lowe water agayne: and at the twelfth and foure fythes of the other day, shalbe ful sea. So that from one day to another, the tyde doth shorten foure fythes of an houre, which is the time that the Moone slacketh or tarieth more then one natural day, to returne to the poynt from whence she departed by the twelue degrees, whereof we haue spoken. Whereby it manifestly appeareth, how they beguyle them selues that say, that the sea increaseth syxe houres, and decreaseth other syxe. For yf it were so, the tydes shoulde euer be at one selfe same tyme and houre. But for as muche as there is more then .xxiiii. houres, by the sayd foure fyfth partes, thereby is caused the variation of the tydes: so that if this day, the tyde be at one of the cloche, to morow it shalbe at one and foure fyfth partes, and the day folowyng, at two of the cloche and three fythes, &c.

The shortning of the tyde.

An errour.

The variation of tydes.

For this accoumpt, I wyll describe a Table in circular figure, although not precise, for the causes whiche we haue touched before in the fyfth Chapter, speakyng of the Moone: who sometymes in her moving is swyft, and sometyme slacketh as much, because the coniunction is not euer in one selfe same poynt of the Zodiacke, as ỹ Mariners presuppose for their rule. This figure shall haue two circles, in the selfe (whiche shalbe the fyrst, and next vnto the center) shalbe the dayes of the Moone, from one to thirtie, whiche we count the coniunction. And in the seconde and greatest circle, shalbe founde the houres of the tydes. So that, who so desyreth to knowe when the tyde shalbe, where it floweth South west and Northeast, let hym at that houre take

A table to knowe the variation of the tydes.

heede to the dayes of the Moone, howe many they are: as if he be in the conjunction, or if it be the fyll or seconde of the Moone. &c. And the day beyng knowen, then in the seconde circle which answereth directly to the day, shall he fynde when shalbe hygh water, or ful sea: and consequently, the ebbe, or lowe water, whiche shalbe syxe houres and one fyfth, after the full sea, and so lykewyse may he iudge when shalbe the halfe tyde: and this aswell at the tyme when it encreaseth (whiche shalbe three houres and halfe a fyfth part of an houre, before the full sea) as also when it decreaseth, which shalbe the halfe ebbe, three houres, and halfe the fyfth of one houre, after the full sea.

¶ The Table followeth.

This increasyng and decreasing of the tydes, is not euer in equall quantitie. In the coniunctions and oppositions, they increase and decrease much, whiche the Mariners cal hygh spring tydes, and the greatest increase of al, they cal the hygh springes. In the quarters of the Moone (whiche are at the. 7. and. 22. of the Moone, or neare there about) they increase and decrease but lytle: which the Mariners cal nepe tydes, low waters, dead waters, or lowe flooddes.

The. xix. Chapter, of certayne signes, whiche prognosticate tempestes, or fayre weather.

A Good Pilot or Mariner, ought not to be ignorant of certayne signes or tokens, whiche the naturall Philosophers describe of tempestes. For as they signifie vnto hym, so shall he leaue his port, or enter into it: whiche yf he canne not, then ought he with patience and hope, to tary the tyme that God hath appoynted for hym, who moueth and troubleth the Seas, when it pleaseth hym, and appeaseth them agayne at his pleasure. Lesse hurteth and damageth the stroke whiche we see comyng, or foresee, then that which hath stricken vs, and taken vs carelesse. When the Sunne ryseth fayre and cleare, it signifieth a fayre day: but if it shewe yealow, or deadly, tempest is like to folowe. Againe, if at the rising of the Sunne his beames shewe themselues contract, or geathered togeather, and short, peu shall haue rayne: if the milles or cloudes make a circle about the Sunne or Moone, how much the greater that circle shalbe, so much greater shalbe the tempest to come: and yf there shalbe two circles, the tempest shal increase the more. And yf it chaunce, that at the rysing of the Sunne the cloudes be turned red, it is a signe of no small tempest. When the Sunne or the Moone shall haue a circle, looke towarde the part where it breaketh, and from thence shall wynde come: yf it depart, or dispearse equally, fayre weather shall folowe. When the Moone riseth hygh and

Signes of faire and fowle weather.

thynyng with pure colour, you may iudge it faire weather: and yf red, winde: yf blacke, rayne. When in the newe Moone, the hornes or corners appeare grosse or great, it is a token of tempest: and yf sharpe, it signifieth faire weather.

The newe Moone.

This that we haue sayde, is the authoritie of Plinie and Aristotle, to whom the prudent Mariner shall credite, vntyll he haue founde other, more certayne, eyther by his owne experience, or by the experience of other wyse men, woorthy to be beleeued. And euery man ought to trauayle as muche as in hym is, for the knowledge of these thynges, accordyng as God hath geuen hym vnderstandyng and reason to obteyne the same: and this shalbe wysedome, bearyng in memorie the experience of thynges past, to gouerne presently, and to prouide for thinges to come. The prouidence of God is so great, that depryuing bruite beastes of reason and vnderstanding, he hath geuen them sense, and naturall instincte, whereby they may knowe that, that men doo vnderstande by reason.

The sense of beastes, in fore seeing tempestes.

By this sense and secrete instincte of nature, the Antes or Pismares, with prouidence and diligence, lay vp in store theyr prouision and egges, when before they feele the rayne to come. The Swalowes also when they feele the winter commyng, passe the Seas. Lykewyse, the Fyshes, when they perceyue stormes to come, goe downe to the bottome of the water, and hyde them in the mudde of the Sea. And although it may seeme beside my profession, to meddle with matters partaynyng to Diuines, yet wyll I not omit to speake that Christe our Lorde sayth, as testifieth S. Matthewe. When the Pharisees with the Saducees (to tempt hym) willed him to shewe them signes from heauen, he answeared, saying, When it is euening, you say it shalbe faire weater, because the heauen is redde: and in the morning, you say it shalbe tempest, when you see that the heauen lowreth towarde redde. &c. They knewe by that they iudged of heauen, to determine thinges to come: as whether it were euyll to take iourney, to enter the Sea, to reape Corne, to lay it abroade, or to geather it in. I saye, that to vnderstande the reason that moued them to haue suche consyderation of tyme,

Antes.

Swalowes.

Fyshes.

Math. xvj.

tyme (whiche we nowe lykewyse obserue) it is neceſſarie to knowe that the redde colour whiche appeareth in the euenyng, ſignifieth the dryneſſe of the ayre, whereby the matter of the groſſe vapours whiche ſhoulde be conuerted into water, is ſo muche dryed, that it appeareth in maner inflamed, and is therefore red, and ſo is it not aptly diſpoſed to be conuerted into water, and is therefore the neareſt ſigne of fayre weather. The other ſigne when the heauen in the morning drawеth towarde reddeneſſe (yet not redde) ſheweth manifeſtly that rayne ſhal folowe. Whereof the cauſe is, that this matter is ingroſſed, becauſe this colour can not be but in groſſe and thycke matter, which is not dryed, and therefore is not redde, as the cloudes that appeare in the Weſt, in the tyme of fayre weather: but it is a matter ſomewhat troubled, and partly redde, and is therefore a confounded matter, which touched with the heate of the Sunne, and therewith broken and diſpearſed, falleth downe, and is conuerted into water. And further, as touchyng the fayde troubled or groſſe matter, I ſay, that the dry and ruddie part thereof, is eyther turned into wynde, by dryeneſſe, or elſe beyng compaſſed about, and incloſed with moyſte matter, is altogether conuerted into rayne, and ſo maketh tempeſt. For by tempeſt is meant, not onely rayne, but alſo tempeſtious wyndes, with water.

The redneſſe of the euening.

Ruddy the colour.

What is tempeſt.

Lykewyſe it is wrytten by Saint Luke, When you ſee a cloude ryſe in the Weſt, you ſay rayne ſhall folowe: and when the wynde bloweth South, you ſay it wyll be hot. &c. To vnderſtande this, I ſay the cauſe of this is, that rayne is made or engendred of moyſt vapours, which both may be, & are ingroſſed. Or otherwiſe a cloude is a groſſe body of moyſte vapours ſo ingroſſed, and when the cloude dooth ſo ryſe, it ſhalbe a ſigne that rayne ſhall ſhortly folowe: For that that was ingroſſed in the cloude, ſhall ſoone be reſolued into water. To the other reaſon, why they ſay that when the wind bloweth South, it wyl be hot I ſay that that wind is hot and dry. Furthermore it is to be conſydered, that the wyndes are ſometymes dry, and ſometymes moyſte, yet not by theyr owne propertie, but according to the re-

Luke. xij.

The generation of rayne or cloudes.

The qualities of wyndes.

gions by the whiche they passe. We see that in some one region it raigneth with one wynde, and the selfe same wynde in other places disperseth the cloudes. The Northwest wynde is dry in Spayne, yet in Lybia it is very moyst and rayny. The South wynde in Europe, causeth rayne in moste places, and therefore the Poetes named it the wynde of waters, and this wynd in Palestina or Jurie is drie. The cause of this diuersitie, is, that when the wynde bloweth in Palestina, it passeth by hot and dry regions, as by the desartes of Affrike, and passeth not by any sea at al. But when it bloweth in these parts of Europe, it must of necessitie passe by, and ouer the waters of the sea Mediteraneum, or the Leuant sea, where it geathereth moysture, and causeth rayne. The Leuant or East winde, in Malaga, and Gibraltar, is moyste, and in Sheres De la Frontera, is hot as Hell.

The. xx. Chapter, of the bright and shyning exhalations that appeare in tempestes, whiche the Mariners call Santelmo, *or* Corpus sancti.

IGnorance is ꝑ mother of errours, and therefore wyll I not omitte to shew the naturall cause hereof, although among certaine simple and ignorant people, it is accounted for a myracle, that in certayne tempestes on the Sea, the Mariners see certayne shynyng and bryght fyres, whiche with great superstition they kneele downe vnto, and pray vnto, affyrmyng that it is Santelmo that appeareth vnto them, & not contented herewith, some sweare that they haue seene drops of greene wax fal downe. Other affirme that this waxe is of such heate, that if it fall from the toppe of the shyppe, it dooeth melte the rosen and pitche of the hatches of the shyp, with suche other foolysh imaginations, and therfore it shalbe good briefly to speake hereof, to

Some cal these the fiers of S. Elin and S. Nicolas.

stoppe

stoppe the mouthes of suche fonde and ignorant persons. The exhalations or vapoures of the grosse fumes or smokes that rise from the earth, are constrayned or geathered togeather by the coldnesse of the nyght, and the ayre, and are thickned in the fyrst region of the ayre, next vnto the earth. This may, and is wont to be enflamed or kindled, and yf it finde a body whervnto it may cleaue, it abydeth in that vntyl it be consumed. This fyre is cleare, and shyneth, and yet burneth not. The Greekes call it Polydures, and the Latines call it Castor and Pollux. It is accustomed to appeare vpon the shrowdes, and oftentymes is seene vpon the pykes of souldyers, in the armies of men of warre, as Plinie writeth, and this, as well by reason of continual smoke, as also by the heate of much people. Certayne it is, that smoke is none other thing then fyre dispearsed: as flame is an exhalation or euaporation that riseth in maner of a smoke, from a grosse or fat body, and at the tyme that it ryseth, beyng geathered togeather, is constrayned into flame, inuesturd with fyre. This respendence or shynyng, is also often tymes seene, not onely in tourneying by lande, but also in sayling by ryuers: and when it appeareth on the lande, it ryseth of the smoke that is geathered togeather with the colde ayre of the nyght, and on the bankes of ryuers: this smoke is geathered of the exhalations of the water, and consequently beyng kyndeled, appeareth bryght and shynyng. But nowe let vs come to the shyppes that sayle by the sea, and to the Mariners that are accustomed to tempestes. To them therefore I say, that that lyght, or suche other lyghtes as they see, is engendered of the fumes and smokes of their shyppe, with the heate of men couched close and neare togeather in a narrowe place, and when a tempest ryseth, the sayde smoke is thickned, preste togeather, and beaten downe by the wyndes, in suche sorte, that beyng tossed from one syde to another, it is set on fyre by mouyng, and taketh holde sometyme on the shroudes, and sometymes on the toppe, and sometyme also in the poupe, or in the foreshyppe: so that to see this lyght, or the same to appeare, is a naturall thing, and not supernatural.

Wandring fyers engendred of exhalations and vapours.

Castor and pollux.

What is smoke and flame.

Exhalations of the land & water.

Exhalations and vapours engendred in shippes.

When Captayne Bezerra was at Cayron, in the Emperours Naule, with his company of Souldyers, he chaunced to be in a tempest, and sawe the sayde fyre of Santelmo, whiche shortly after descended so lowe, that the captayne might easily come to it: and takyng it in his cloke, he founde it to be a litle dyoppe of water. Some haue thought it to be a certayne shyning Flie, called Taros, which the sea men some time see in a calme in the Sommer season: and thus Santelmo appeared no moze. The Captayne remayned astonished at the mockerie, and the other percepued it to be no miracle. The opinion of the Maryners that affirmed it to be Santelmo, may ryse of Saynct Eraſmo, Bysshop of Naples, who (as they say) not only in his life time, but also after his death, was a patrone and helper of Mariners that called vpon him in tempestes. This name of Eraſmo, they of Naples call Ereemo: and processe of time taking away one e. by the figure of Syncope, remayned the name of Santermo. And the Spaniardes, who neuer can long keepe any strange vocable, call it Santelmo, turnyng r. into l. Yet of this Santelmo, whereof the Maryners speake, there is neyther scripture that maketh mention, nor auctoritie that confirmeth it. I heare say, that the Frier preachers hadde a religious man, of commendable life, and good conuersation, named Frier Pero Gonzales, borne in Galizia, and that in his life tyme our Lord dyd certayne miracles by hym, and that this is he that shyneth and geueth lyght in tempestes. No doubte, but GOD worketh myracles in his Saintes, and by his Saintes, as sayth Dauid. Psalm. lxvii. But yf this seruant of GOD was Pero Gonzales, howe then shal he be Santelmo? Another difficultie there is, as touchyng this light: for there are witnynges of more antiquitie then the lawe of grace, and commyng of Christe in flesshe, whiche geue testimonie hereof. For the Poet Virgyll, in the second of his Aeneidos, wryteth, that this fire appeared vpon the head of Iulius Ascanius. And Titus Liuius in his first booke, affirmeth, that it appeared vpon the head of Seruius Tullius, the sixth Kyng of the Romanes.

A shining flye

A superstitious opinion of the Mariners.

A lye of the fryer preachers.

Psalm. lxvii.

Testimonie of auncient authours.

Pom-

Pomponius Articus sayth, that Rome begunne to be buylded in the thirde yeere of the thirde Olimpiades, that is, in the tenth yere of Ionathan kyng of the Iewes, and from the creation of the worlde. 3201. yeeres, and. 729. yeeres before Christe our Sauiour was borne. The kynges of Rome were seuen, and raigned. 244. yeeres. Eusebius sayth, they raigned 246. Seruius Tullius, raigned. 44. yeeres, Tarquinus superbus. 25. yeeres after hym. So that discountyng these yeeres, it shall appeare clearely as I say. Although the yeeres were not discounted, let them reade Diadorus Siculus, an auncient wryter, let them reade Plutarchus, Aristotle, and other olde aucthours that haue written hereof, and they shall finde, that yf tempestes be neare vnto the Sea, these fyres and lyghtes appeare in them: and appeared not onely to the Gentiles, but at this day also appeare to the Turkes & Moores in tempestes. When onely one lyght appeareth, it is taken for an euyll signe: And hereof sayde Propertius thus.

The buildyng of Rome.

The Romane Kinges.

Candida fœlici soluite vela toro.

And why it is an euyl signe, this is the cause: that if the tempest that ryseth be great, it choketh the exhalation, although yet by the part least troubled, it appeareth. When there are two lightes, it signifieth that in the ayre is great abundance of grosse humours, & is a token that it is sufficient to consume the matter of the tempest, or that the tempest beginneth to ceasse, and the grosse humour hath the maisterie. But sometyme it chaunceth, that two lyghtes appearing, there may be a tempest, and one appearyng, shall not be so great, and often tymes there is a tempest without any light at all seene. The blinde gentilitie called these Castor and Pollux, and placed them in heauen in the signe of Gemini.

One lyght or fyre is an euyll signe.

Two lightes.

Castor and Pollx.

Nowe remayneth to answeare to one obiection of the Marriners, who say, that neuer man that hath seene these Fyres, hath peryshed. To this I say, that many may see, and haue seene these lyghtes, of whom, some haue been in peryll, and some drowned: Notwithstandyng, no man

An errour of the Mariners

man can affirme, that if the drowned might speake, they would say that they haue seene them. Therfore the wyse Christian Beryner ought to haue a cleare conscience, and to call for the helpe of almightie GOD, lyfting vp his eyes and hands vnto heauen, and say with the Prophet, Saluum me fac Deus, quoniam intrauerunt aquæ vsque ad animam meam. Saue me, oh my God, for waters haue entred euen vnto my soule.

Psalm. lxviij

Here endeth the seconde parte.

The third part, entreateth of the composition and vse of Instruments, and Rules for the Art of Nauigation.

The first Chapter, of the number, order, and names of the windes.

SO greatly estemed was Eolus, king of the Eolas Ilandes, or Ilandes of Vulcane, for hauyng reason and knowledge of the wyndes, that they of auncient tyme called hym the god and lord of them. With no lesse consyderation, the prudent Mariner ought not to be ignorant of them, for as muche as the vniuersall benefite, and commoditie of Nauigation consisteth therin. And to haue the better knowledge therof, you shal vnderstande, that wynde is fruite of the ayre, and vapour of the earth: the which by reason of his subtiltie, pearceth the ayre, striketh it, and enforceth it. Other say, that wind, is ayre, moued or tossed by the vehement influence of vapours of contrarie qualitie. It is in Latin called Ventus, because it is vehement, and violent, whose force is so great, that it ouerthroweth not onely heapes of stones, or rockes, and casteth downe trees: but also disturbeth the ayre and the earth, and moueth the seas. There are foure principal wyndes, which come from the foure cardinall or principall pointes of the Horizon. We haue sayd that the Meridian circle, cutteth the Horizon in two poyntes (that is) in the North and in the South, and the Equinoctial cutteth it in other two, that is, in the East and West, and from these foure poinges come these foure wyndes, whereof alsb the holy Scripture maketh mention. These foure wyndes, they in auncient tyme, named in this maner. That that commeth from the East, they called Subsolanus, whiche we cal the Leuant, or East wynde.

Why Eolus was feyned God of winde.

What is winde.

The foure principal or Cardinall wyndes.

Luke. xvij.

East.

That

South. West.

That commeth from the South, they named Auster, whiche we call the Meridian, or South wynde. That commeth from the West, they call Faucinus, whiche we call the Ponent or West. That from the North they named Septentrio, or Aquile, or Boreas, whiche we cal North. To euery of these foure wyndes, they adioyned two collaterall wyndes, in maner as followeth. That that is from the East towarde the part of the North, where the Tropike of Cancer arpleth, or cõmeth forth, they called Vulturnus: and that that is from thence toward the part of ỳ South, where ryseth the Tropike of Capricorne, they called Eurus: also that is from the West toward the part of the South, where the Tropike of Capricorne goeth downe, they cal Aphricus: & that that declineth to the North, where the Tropike of Cancer goeth downe, they cal Caurus. The Collaterals of the North and the South, answeareth to the circumferences of the Polar circles: that that is from the North towarde the Leuant, or East, they call Aquilo: and that declineth towarde the West part, they cal, Circius: that is from the South toward the East, Euro Auster, and toward the West, Euro Aphricus: thus many hath Aristotle in his Metheora. With these .xii. windes, they sailed in old time, & made their compasse by them.

Collaterall wyndes.

Twelue wyndes.

The Hydrographers of late dayes, & such as are trauayled & exercised in sayling, agree with the auncients in the foure principal windes, although they haue chaunged the names, callyng the Leuant, or Orient, East: ỳ Ponent or Occident, West: the Septentrional, North: and the Meridional, South. Betweene these foure windes, they deuide euery quarter of the Horizon, into two halfes, made of the two nearest, in this maner. Betwene the North and the East, takyng name of them both, they name the Northeast. Betweene the East and the South, they name the Southeast: and betweene the South and the West, Southwest: betweene West and North, Northwest. These eyght wyndes in nauigation, they call whole wyndes.

Eyght whole wyndes.

Diuision of the Horyzon by the foure principal wyndes.

Betweene these eyght wyndes, they place other eyght, that are called halfe wyndes, whiche also are named of the two that are nearest vnto them. That that is betweene the North and Northeast, they call Northnortheast,

Eyght halfe wyndes.

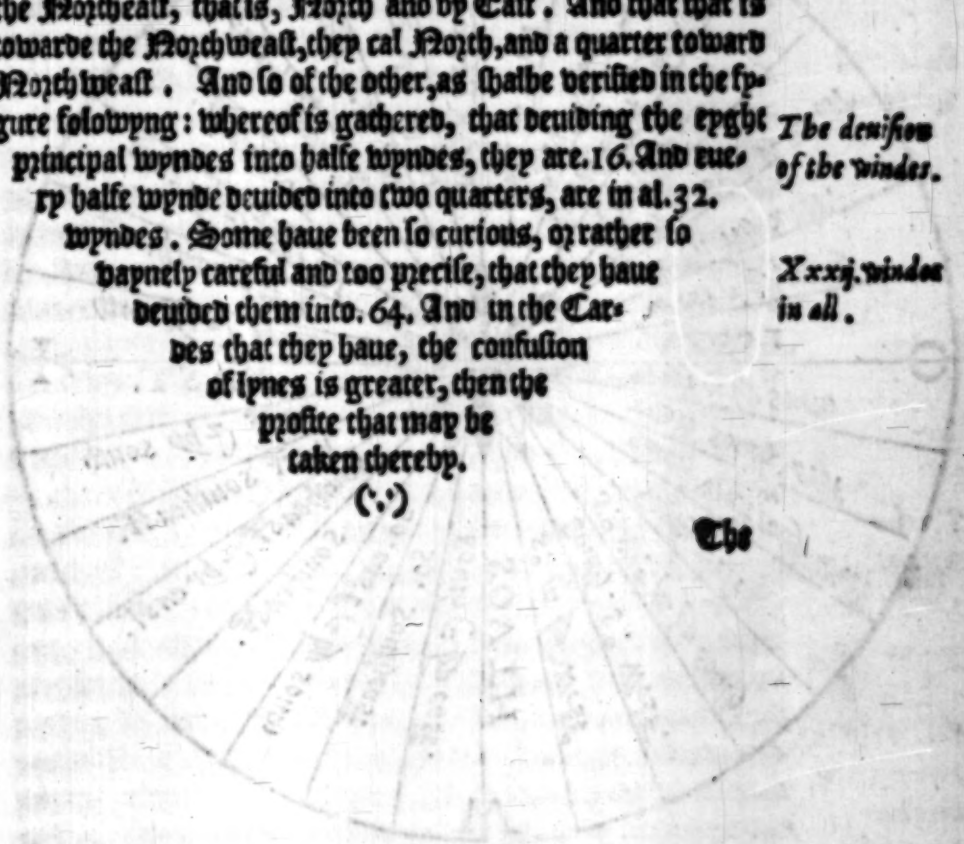
betweene

Betweene North East, and is East Northeast: and so foorth of the other. Beside these halfe windes, they haue other whiche they call quarter windes. These take the name of the windes to the which they declyne: as yf to the quarter from the North, towarde the Northeast, they cal it North, and a quarter towarde the Northeast, that is, North and by East. And that that is towarde the Northweast, they cal North, and a quarter toward Northweast. And so of the other, as shalbe verified in the fygure folowyng: whereof is gathered, that deuiding the eyght principal wyndes into halfe wyndes, they are. 16. And euery halfe wynde deuided into two quarters, are in al. 32. wyndes. Some haue been so curious, or rather so vaynely careful and too precise, that they haue deuided them into. 64. And in the Cardes that they haue, the confusion of lynes is greater, then the profite that may be taken thereby.

Quarter windes.

The deuision of the windes.

Xxxij. windes in all.



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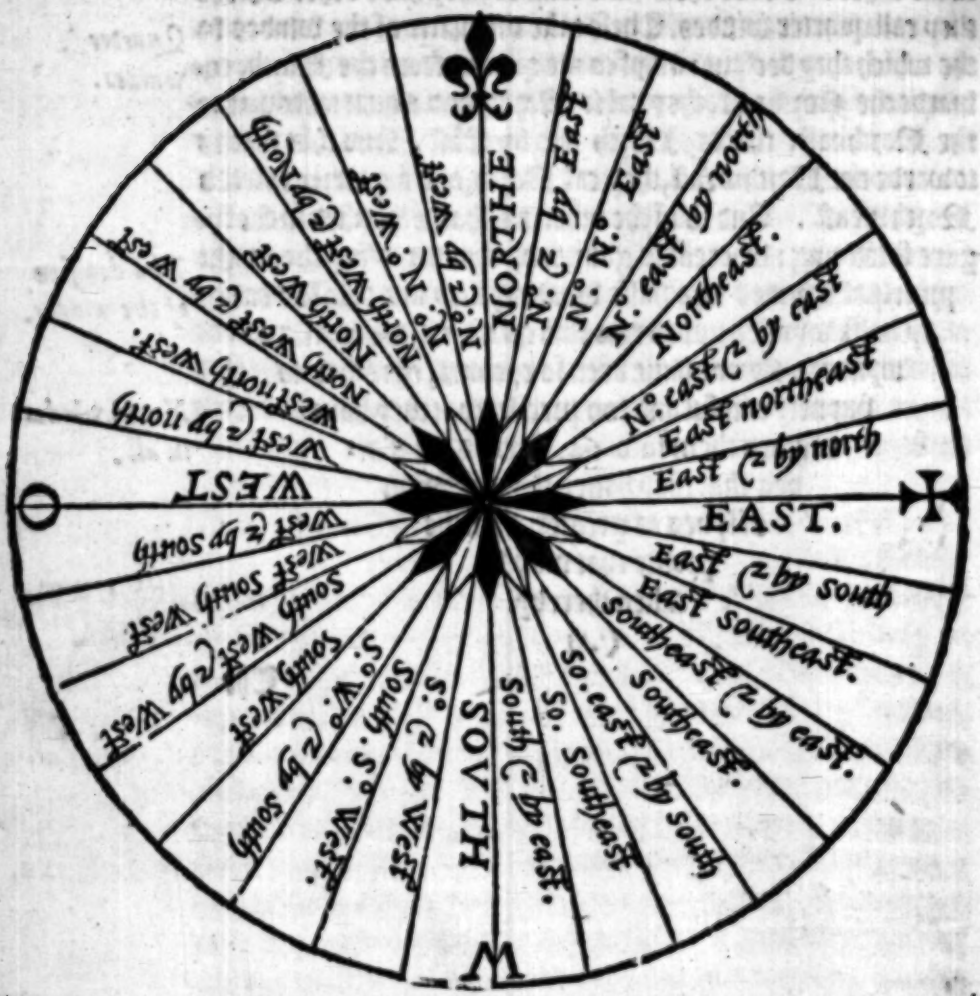
The

The demonstration of the wyndes.



These names doo they vse that sayle by the Ocean Sea. And it seemeth that they had theyr beginnyng of the Almaine or Flemish tongue: For these nations cheefely sayle in the Ocean. They that sayle in the sea Mediteraneum, or Lenant sea, call them by other names, taking original of the Tuscan or Italian tongue. Or els that they haue denomination of the partes from whence they come, in respect of the sea Mediteraneum, as the wynd called Græco, because it commeth from Grecia, and Libeco,

The names of the windes in the Italian or Tuscane tongue.

Libeico, because it commeth from Lybia, and Syrocco, because it commeth frō Syria, and begynnyng at the North, these are theyr names, Tramontana, Græco, Leuante, Ponente, Maestro, and that that is betweene Tramontana and Græco, they call Græco Tramontana, and that is betweene Græco and Leuante, they call Græco Leuante, & that is betweene Leuante and Syrocco, they call Leuante Syrocco, and that is betweene Syrocco and Mezzo Iorno, they call Mezzo Iorno Syrocco, and so of the other: and the lyke of the quarters. And because they that sayle in the Ocean, are gouerned by altitudes, we wyl vse the names that they vse, where we intende to intreate of altitudes, and euery man shall vse them as he lysteth, for as muche as the difference is not in the windes, but only in theyr names.

The seconde Chapter, of the composition of Cardes for the Sea.

What is Nauigation.

ARryuyng to the ende desired (which is Nauigation, the principal intent why I began this worke) I say, that Nauigation or sayling, is none other thyng then to iourney, or viage by water, from one place to another, and is one of the foure difficultest thynges, whereof the most wyse kyng hath written. These viages do differ from viages by lande, in three thynges: for the lande is fyxme and stedfast, but this is fluxible, waueryng, and mooueable. That of the lande, is knowen and termined by markes, signes, and limittes: but this of the sea, is vncertayne and vnknowen. And yf in viages by lande, there are hylles, mountaynes, rockes, and craggie places, the sea payeth the same seuen fold with tormentes and tempestes: therefore these viages beyng so difficult, it shalbe hard to make the same vnderstoode by woordes or writing. The best explication, or inuention, that the wittes of men haue found for the manifesting of this, is to geue the same paynted in a Carde.

Prouerb. xxx.

The daunger and difficultie of Nauigatiō.

For

Making of Cardes for the Sea.

For the draught, or makyng whereof, it shall be requisite to know two thinges: whereof the one is, the right position of places, or placing of countries and coastes. The other is, the distances that is from one place to another, and so the Carde shal haue two descriptions. The one that answeareth to the position, shalbe of the wyndes, which the Mariners call lynes or poyntes of the compasse: and the other that aunsweareth to the distances, shalbe the drawyng and poynting of the coastes of the land, and of the Ilandes compassed with the sea. To paynt the windes, or lynes, you must take skynnes of Parchment, or large Paper, of suche bygnesse as you wyll the Carde to be, and in it drawe two ryght lynes with blacke inke, whiche in the middest shall cut or deuide them selues in ryght angles, the one accordyng to the length of the Carde, which shalbe East and West, and the other North and South. Vppon the poynt where they cut, make a center, and vppon it, geue a yuine or byd circle, whiche may occupie in maner the whole Carde. This circle, some make with lead, that it may be easily put out: these two lines deuide the circle into foure equal partes, and euery part of these shall you deuide in the myddest with a pricke or puncte. Then from one puncte to another, drawe a ryght Diametrall lyne with blacke incke: and so shall the circle remayne deuided with foure lynes, into eyght equal partes, which corresponde to the eight windes. In like maner shal you deuide euery of the eight into two equal partes, and euery part of these is called a halfe wynde. Then drawe from euery punct, to his oppolite Diametrally a right lyne, of greene, or azure: lykewyse shall you deuide euery halfe wynde in the circle, into two equall partes. And from these punctes, whiche deuide the quarters, you shall drawe certayne ryght lynes with redde inke, whiche also shall passe by the center, whiche they call the mother Compasse, or cheefe compasse of the Carde, beyng in the myddest thereof: and so shall come fourth from the center, to the circumference. 32. lynes, whiche signifie the. 32. windes. Beside these sayde lynes, you shall make other equal distant to them, and of the selfe same colours, in this maner. From the poyntes of the wyndes and halfe wyndes that passe by the center, drawe certayne ryght lynes, that passe not

The windes or lines are called Rumbos, in the Spanishe tongue.

The mother compasse of the Carde. 32. lines whiche signifie so many wyndes.

not by the center, but be equally distant to those that passe by the center, and of the same colours and equidistance, as are they that passe by the center. And as these lynes concurre togeather aswell in the center as in the poyntes of the wyndes, and halfe wyndes, that are in the circumference of the circle, they shall leaue, or make there other syxteene compasses, euery one with his thyrde and two wyndes. And yf the Carde be very great, because the lynes may not goe farre in sunder, yf you wyl make there other sixteene compasses, you must make them betweene the one and the other of the fyrste syxteene poyntes, where the quarters are made with theyr wyndes, as we haue sayde. It is the custome for the most part, to paynt vpon the center of these compasses, a flower, or a rose, with diuers colours, and gold, differencyng the lynes, and markyng them with letters and other markes: especially signyng the North with a flowre Deluce, and the East with a Crosse. This, beside the distinction of the wyndes, serueth also for the garnishyng of the Carde. And this for the most part is done after that the coast is drawen. And thus muche sufficeth for the draught of the wyndes.

The placyng of many compasses in the Carde.

The flower, or rose of the center.

The North.

The situation of the places. Portes, and Flandes in the Carde, accordyng to theyr proper differences, consysteth in the particuler, and true relation of suche as haue trauayled them, and therefore for this purpose it shalbe needefull to haue paternes of coastes, portes, and Flandes, whiche must be paynted in the Carde, and these of the best & most approued to be true: and not only to haue paternes wel paynted, but also it shalbe necessarie to know the true altitudes of the Pole, of certayne principal Capes, Portes, and famous Cities. This doone, they must be translated into certayne thinne papers, and transparent, that may be seene through, and those of the best and fynest that may be had, annoynting them with oyle of Line seede, and then dryyng them at the Sunne. Then take the paterne or Carde that is to be translated, and reache or stretche it fourth vpon a table. Then put the transparent paper vpon the one side of the paterne where you wyl begyn. And the paper being made fast vpon the

The situation of the places. &c.

Translation of the Carde, from one to another.

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The situation of the places. &c.

Translation of the Carde from one to another.

paterne with plomettes of leade, or a lyele waye, that may eaſily be taken of, you ſhal in the tranſparent paper marke with a fine penne, one Eaſt and Weſt, and one Northe and South, or two, vpon thoſe that are ſeene by the ſelfe ſame paper in the paterne. And this is called tracyng, or tranſlatyng. In lyke maner ſhall you trace al the coaſtes, hauens, portes, Ilandes, cities, Capes, and riuers, as appeareth in the paterne, vnto the rockes that come foorth of the water, and the knowen bankes. And becauſe this paper dooth not ſuffice, you ſhall put thereto another, and more, as nede ſhal require. And begyn the tranſlation in one, where the other endeth, vntyl you haue tranſlated all that you deſyre, not forgettyng to make in euery one, lynes of Northe and South, Eaſt and Weſt, to ſerue for markes afterward. So that the lyne of Northe and South, of the one paper, may ioyne cloſe and euen, with the lyne of the Northe and South of the other paper that is ioyned to it by longitude.

And the paterne thus tranſlated into theſe papers, you muſte put the ruled or lined paper or papers vpon a playne, ſmoth, and ſtedfaſt table, where you ſhal ſtretche them foorth, and make them faſt with plomettes or weightes, or nayle them to the table by the ſides and corners, with ſmal nayles. Then vpon the ſayd ruled paper, you ſhal put the paper that is tranſlated from the paterne, in that ſide or part that is correſpondent from the paterne, to the ruled Carde, ſo that the lynes of Eaſt and Weſt, Northe and South, of the tranſlation, may be vpon the lynes that anſweare to them in the ruled Carde.

This paper thus made faſte by the one ſyde or parte, you ſhal by the other ſide (that it may remayne in his place) put vnder it an other fyne paper, ſmoked or ſmyred on the neather moſt parte (whiche is that, that falleth vppon the ruled Carde) eyther with a lynke, or with matches of pitche. Theſe thus ordered, and made faſt one vppon another, you ſhal take a ſteele bodkyn, or wyre, with a ſmoothe and blunt poynt, that it race not, or bore not the paper, and with it ſhal you drawe, preſſyng vppon al the tranſlation, and tracyng it with diligence

Some doo this only with oyle.

Tracyng of the Carde.

and

and discretion, marking euer how much in it is translated from the paterne: sauyng the wyndes or lynes whiche the Maryners cal Rumbos, and so shal remaine al the impression of the smoke in the ruled Carde, vppon the whiche, with a fyne penne you shal trace with ynke: whiche beyng drye, you shal with crummes of bread make it cleane from al the smoke, and so shal the coaste appeare in the Carde drawen with ynke.

This doone, then with a small penne shal you describe in the Carde, al the places and names of the coaste in that parte where they are, and as they are seene in the paterne. And first, you must describe in redde, the Portes, principal Capes, famous Cities, with other notable thynges: and al the residue in blacke. Then shal you drawe or paynte Cities, Shippes, Banners, and beasties, and also marke the regions, and other notable thynges. Then with colours and golde shall you garnysche and beautifie the Cities, Compasses, Shyppes, & other partes of the Carde. Then shal you set fourth the coastes with greene, by the shore or bankes of the landes, and make them fayre to syght with a litle saffron, or otherwyse, as shal seeme best. Lykewyse shall you describe certayne letters, with theyr significations, in this maner. *The paynting of the Carde*

B. for a Bay. C for a Cape. A. for an Angle. I. or Y. for an Islande. M. for a Mountayne. P. for a Porte. R. for a Ryuer.

Then in place where is more roome, or that is least occupied, you shal drawe two ryght lynes, equally distaunt: and the one no further from the other then halfe a finger, or litle more, and so long, that betweene the may be marked at ỳ least three hundred leagues. And this the Maryners cal the truncke or scale of leagues, and place it or dyse it in this maner. They take with ỳ compasse, a hundred leagues of ỳ trunke of the Carde or paterne that is translated, and they set them iust betweene the two lines, and this space they part by the halfe, and reste the foote of the compasse in 50. and these deuided agayne equally in two partes, they reste the compasse in. 25. and the 25. beyng lykewyse deuided, *The making of the trunke or scale of the leagues.*

they rest in.xii. leagues and a halfe, and marke them as appeareth in the demonstration folowyng.

The graduation of the Carde.

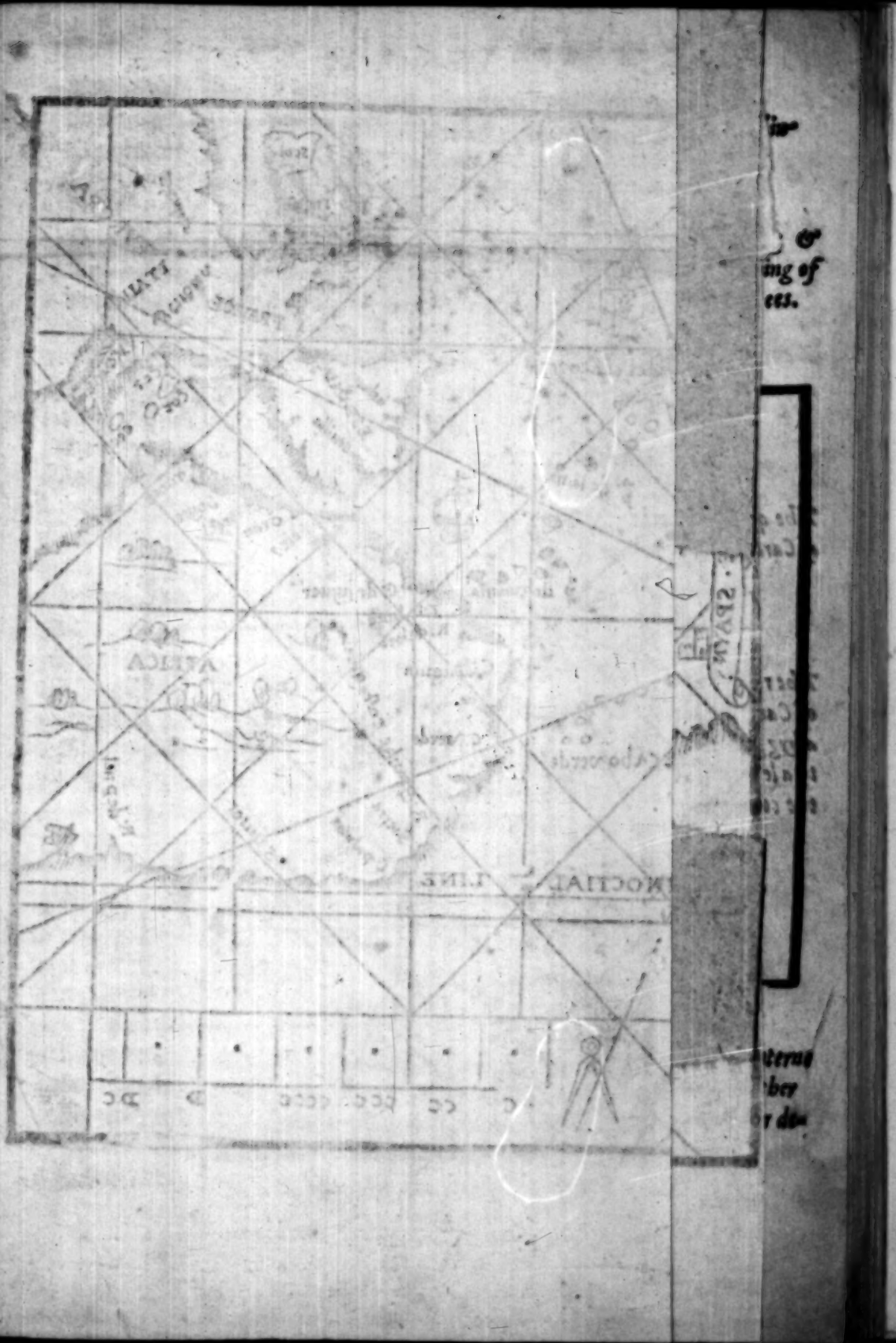
The carde beyng thus made, then to graduate it, or deuide it into degrees, you must drawe three lynes, whiche make ryght angles with the lyne of East and West, equidistant to the lyne of North and South: and they also shalbe North and South. These shalbe drawen by the Ilandes of Asores, or Soria, or nearer to Spayne, or where the Carde shalbe lesse occupyed. And for this purpose, the one lyne must be so farre distant from the other, that in the two spaces which they make, may be marked, in the one, the degrees, & in the other, the number of them, conformable to the graduation of the paterne: as the numbers of degrees shew East and West, with the portes, capes, and coastes in their proper altitudes.

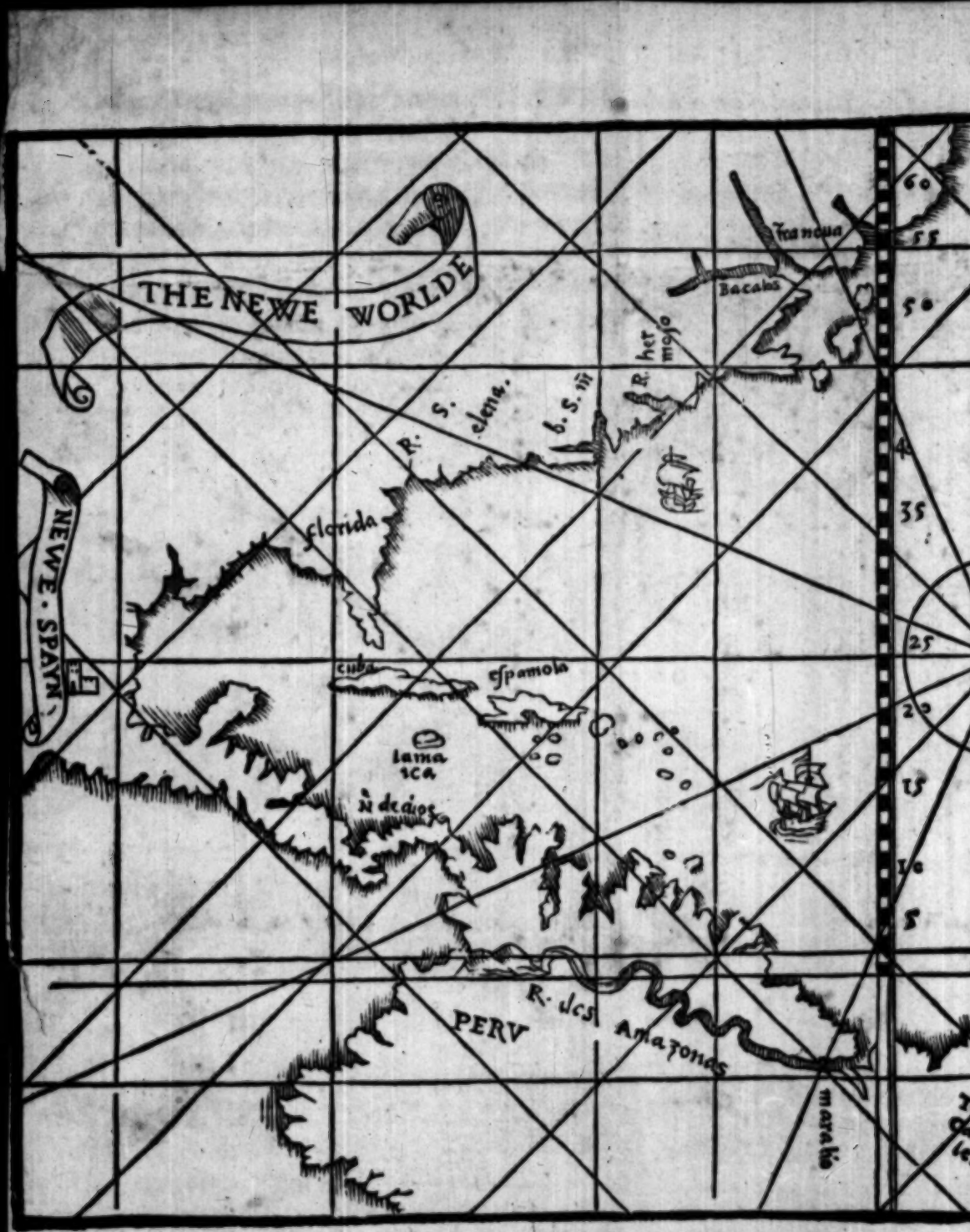
And yf the Carde haue no graduation, you shal take with the compasse in the trunke of the leagues, seuen spaces of. 12. leagues and a halfe, whiche are. 87. leagues and a halfe. And these must be deuided into fiue partes, which come forth at. 17. leagues and a halfe for a parte: and the foure partes taken with the compasse, make foure degrees, and deuided into foure partes, euery part is a degree, and is marked thus. o

The mar'e of a degree.

And yf you wyl make the degrees at. 16. leagues, and two terces or more: you shal geue to euery degree so muche space as the leagues comprehende. This graduation must be begun from some one cape, whose altitude of the Pole is wel knowen. And the whole Carde beyng thus graduate, you must begyn the number of the degrees from the Equinoctial lyne, one, two, three. &c. towarde the one Pole, and the lyke towarde the other: so that to the knowen Cape, may answeare the number of his altitude. And so shal you doo to the whole Carde. Also, the Equinoctiall lyne shalbe marked in his proper place.

And




THE NEWE WORLDE
NEWE · SPAYN
florida
R. S. elena.
b. S. m̄
R. her mojo
Bacalos
cuba
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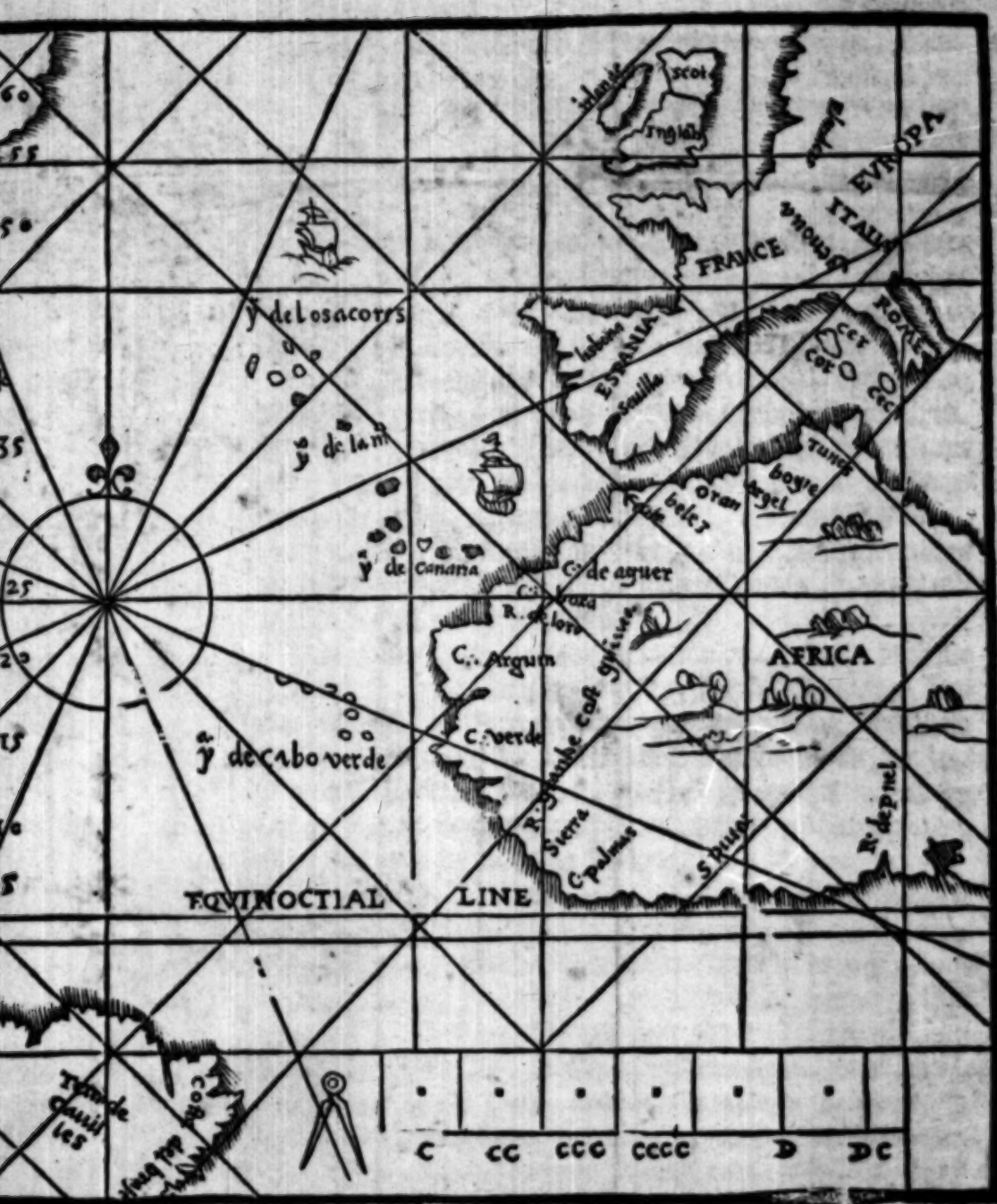

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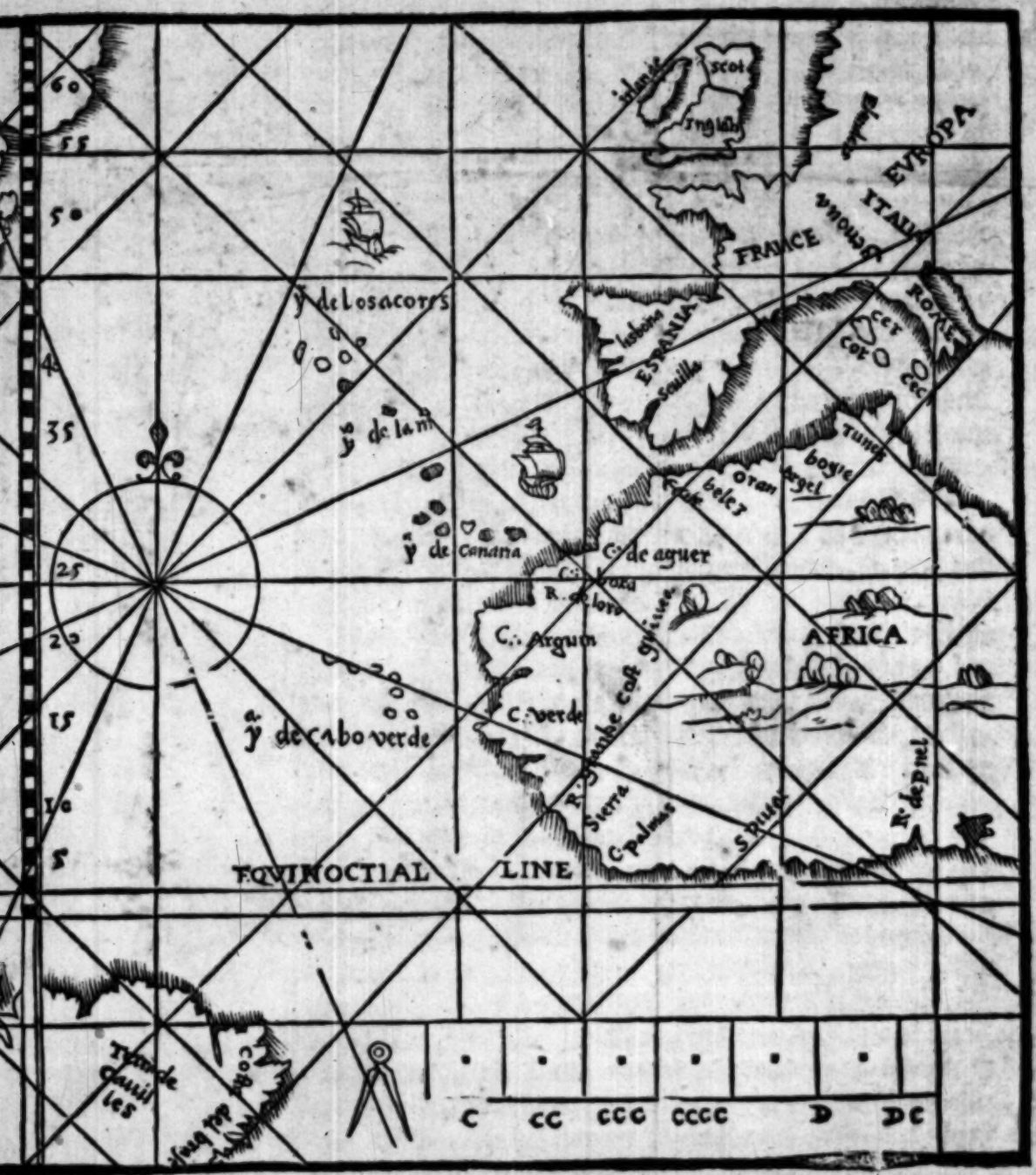

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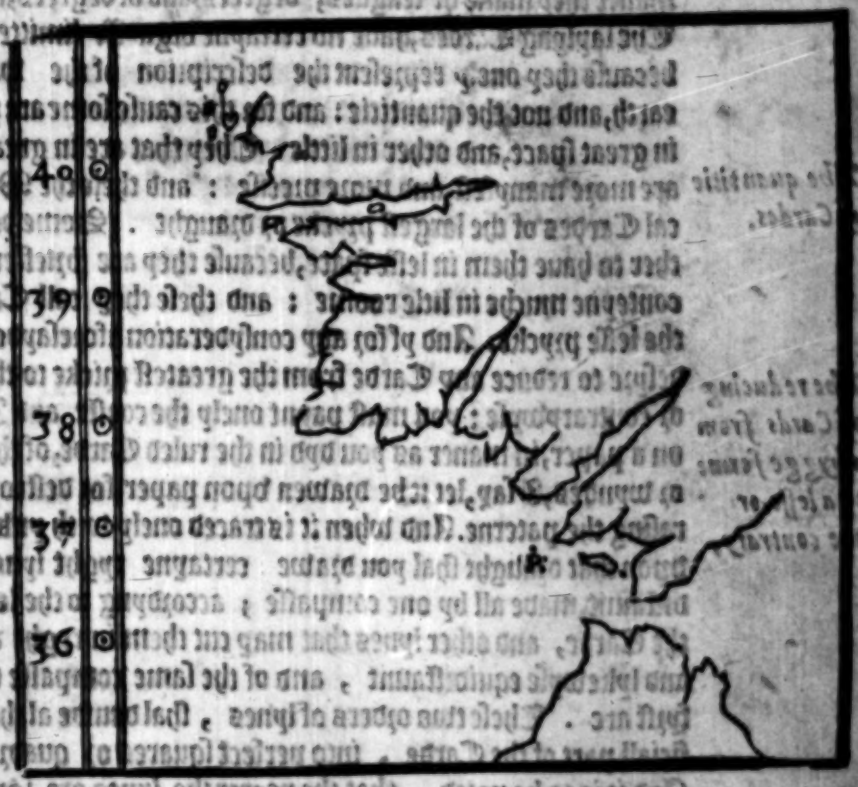
And in lyke maner shal you marke the Tropikes according as they are in the sphere. But forasmuch as in Spayne, Cape saint Vincent is the principal, they begyn there to make graduation, & number it in. 37. degrees. And from thence, toward the Pole Arctike, the degrees do encrease. And from thence towarde the Equinoctial line, they diminisher and from that lyne, to the pole Antarctike, they encrease agayne (as we haue sayd) as is conteyned in the Carde, and as appeareth in this demonstration folowyng.

Cape. S. Vincent.

Increasing & diminishing of the degrees.



And yf the paterne haue neyther leagues nor degrees, you must take or knowe the altitudes of two Capes, that are North, and South, of the degrees, and the difference of the degrees of the elleuation, that is from the one Cape to the other, & shal deuide al that space in so many partes, and so eche one parte shalbe leuenteene leagues and a halfe, as answereth to one degree.

If the paterne haue neyther leagues nor degrees.

gree. Or accordyng to the opinion of the leagues of the roundenesse of the earth, as we haue sayde, as touchyng this in the eyghteenth Chapter of the fyrst part. In Spayne they vse with the compasse to take the space that is from Cape saint Vincent, to the myddest of the greatest Ilande of Berlinga, whiche they account three degrees: so that after seuenteene leagues and a halfe for a degree, they are 52. leagues and a halfe: and so much do they put in this space. Other put fyftie leagues, accomptyng after syxteene leagues, and two terces for a degree, and in this maner they make of leagues, degrees, and of degrees, leagues.

The quantitie of Cardes.

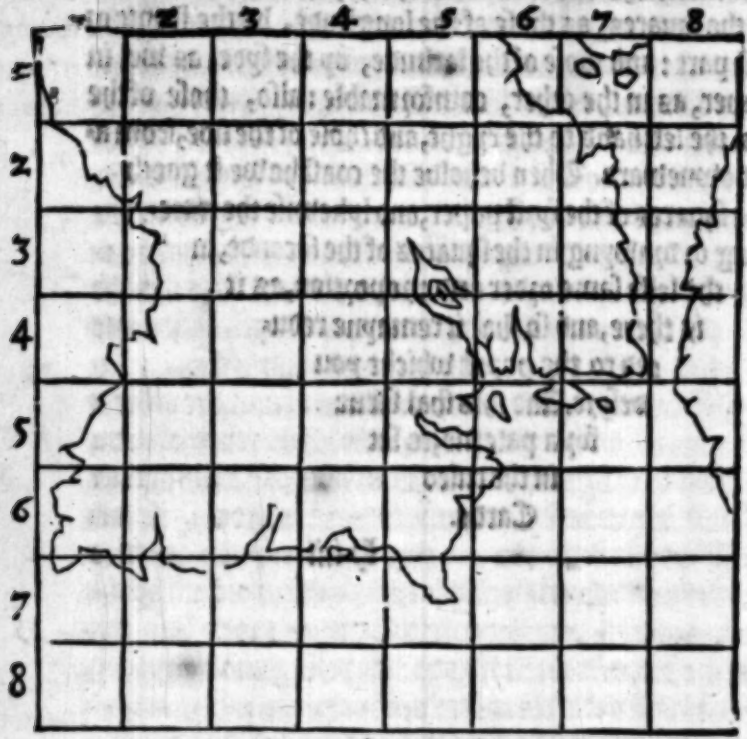
The saylyng Cardes, haue no certayne bignesse limitted them, because they onely represent the description of the water and earth, and not the quantitie: and for this cause some are paynted in great space, and other in little. They that are in great space, are more manyfest, and more precise: and these the Maryners cal Cardes of the largest pryche or draught. Some desyre rather to haue them in lesse space, because they are lyghter, and conteyne muche in litle roome: and these they call Cardes of the lesse pryche. And yf for any consyderation aforesayde, you desyre to reduce any Carde from the greatest pryche to the least, or contrarywyse: you must paynt onely the coaste and Ilandes on a paper, in maner as you dyd in the ruled Carde, of the lynes or wyndes. I say, let it be drawen vpon paper, for destroying or rasing the paterne. And when it is traced onely with pynke, then vpon that draught shal you drawe certayne ryght lynes equidistaunt, made all by one compasse, accordyng to the length of the Carde, and other lynes that may cut them in ryght angles. and lykewyse equidistaunt, and of the same compasse that the fyrst are. These two orders of lynes, shal deuide al the superficiall part of the Carde, into perfect squares or quadratures. And it is to be noted, that the nearer the lynes are ioyned togeather, and the squares the lesse, so muche the more perfectly may it be reduced, and more easily. Then shall you take another paper, greater or lesse then the Carde, accordyng to the poynt that you desyre to reduce it vnto, and in the length and breadth thereof, you shal deuide so many spaces as are betweene the lynes of the other paper, and yf it be

The reducing of Cards from a bygge forme to a lesse, or the contrary.

greater

greater, the squares shalbe greater: and yᵗ lesse, lesse. To keepe order in the correspondence of the squares (which shalbe a great lyght to translate the one from the other) you shall number the orders of the squares, as those of the longitude, by the fronte or vppermost part: and those of the lattitude, by the syde, as wel in the one paper, as in the other, conformable: also, those of the front, from the left hand to the ryght, and those of the side, from aboue, downeward. Then beholde the coast howe it goeth by the squares of the fyrst paper, and lykewise the traceyng or drawyng in the squares of the seconde, in the lesse same order and proportion, as it is there, and so shal it remayne reduced to the poynt whiche you desyre. And this shal serue for a paterne, to set in the ruled Carde.

Here foloweth the maner of trowslatyng the Carde from one fourme into another, greater or lesse.



Here foloweth a similitude of the Maryners Carde.

The pilots and Mariners neither vse nor haue the knowledge to vse other Cardes, then onely these that are playne, as I haue sayde. The which, because they are not Globus, Sphericall, or rounde, are imperfecte, and faile to shewe the true distances. For in howe much they departe from the Equinoctiall, toward whiche so euer of the Poles, the Meridian lynes are contracte narower and narower: In suche maner, that yf two Cities or poyntes in the Equinoctial, should be distaunt of longitude. 60 leagues, and in the selfe same Meridian at. 60. degrees from the Equinoctial, towarde eyther of the Poles, shoulde be other two Cities or poyntes, they should be distaunt in longitude but onely. 30. leagues. And for the better declaration and vnderstandyng hereof, I say, that yf two shyppes shoulde departe from the Equinoctiall, the one distaunt from the other a hundred leagues by East and Weast, and that eyther of them shoulde sayle directly by his Meridian towarde the North: then when eyther of them hath the Pole ouer his Horizon. 60. degrees, the one shalbe distaunt from the other onely. 50. leagues by the Paralelle of East and Weaste, as appeareth by the playne Cardes, that they haue the selfe same hundred leagues. And besyde these consyderations, one error bringeth in an other, & so another an other. Whereof to speake any more here, it shalbe to certayne Pilots (as ẏ prouerbe saith) not only to geue musyke to the deafe, or to paynt a house for blynde men, but shal also be an endlesse confusion. Furthermore it is necessary to consyder, that good Cardes ought to haue the Coastes, Ports, Cities, and other places, situate accordyng to the wyndes or lynes thereof, proportionally as they are in the worlde: and not by the wyndes that the compasse sheweth. This I say for the Northeastyng or Northwestyng of the compasse (called the variation) as hereafter I wyl touche in the fyfth Chapter. And lykewyse shal you diligently obserue, that the graduation of ẏ Carde shewe the same in their proper altitudes. The cardes that lacke this, ought to be corrected and amended by wise and expert men:

The playne Cardes are imperfecte.

Example of errour in the playne Cardes.

The ignoraunce of certayne Pilots.

Good Cardes.

The variation of the compasse.

Altitudes.

Sauyng

In the narowe seas they sayle not by the elevation of the Pole.

Sauing that in the Leuant sea (called Mare Mediterraneum) and in the Chanell of Flaunders (called the narowe seas) it is not conuenient for the nauigation, that the Portes be marked in the Cardes by the wyndes, whiche the compasse sheweth, for as muche as they sayle not by the altitudes of the Pole. Lykewyse, it shal not be inconuenient, but rather very necessary (to auoyde so many errours, of the which do flowe great daungers, and suche a confusion) that your Maiestie shoulde commaunde certayne lerned Cosmographers, and expert in the arte of sayling, to verifie the altitudes of ỹ Pole, that are of Portes, Capes, Flandes, and people by the coastes of the Sea, and in like maner truely to describe the coastes of the lande, especially of the Nauigation of the West Indies, or Mundo Nueuo, where it hath pleased God that so many nations and people haue receyued the water of holy baptisme, commyng to the knowledge of the true God, whereby the Christian empire is greatly amplyfied, besyde the great rychesse had by the sayde Indies. And this hath God miraculously wrought by the conquestes of your Maiestie, in subduyng infidels, and gentiles, to the obedience of the true Catholique fayth. Whereby, not onely God hath been well pleased, but also your Maiestie hath receyued perpetual fame, with eternal renowne, and immortal glory to your posteritie in woldes to come.

Correction of the sea Carde.

The West Indies.

Charles the fyfth.

The.iii. Chapter, of the vertue and propertie of the Lode stone, called in Latine Magnes, and in Spanishe, Piedraymon.

The

The Lode stone (as wryteth Cardinall Cusanus) hath substaunce, vertue, and operation. His vertue is engendred of his substaunce, essence, or beyng, and of his essence and vertue proceedeth his operation and effect, in suche sort, that this stone communicating his vertue to iron, by reason thereof, causeth the iron to moue, although betweene the one and the other be a cuppe, or plate of syluer, or a table, or any other lyke thyng.

The vertue, substance, and operatiō of the Lode stone.

The attractiue, or drawyng force of the Lode stone, causeth the nature of iron to be and rest in it, and that so hymely and quietly, that being naturally heauie and ponderous, it descendeth not. because his nature resteth not in hym selfe, but is vnite with the nature of the stone, whiche seemeth to extende it selfe, and as it were to caste forth a lyuely spirite of enchaunting vertue. Insomuche that (as we see by experience) by the sayd vnion, it not onely distributeth his vertue to one iron, but that iron likewyse to another, and that other agayne to another: and so forth, vntyll of many rynges or lynkes of iron, be made a chayne.

Vertue attractiue.

Cusan applyeth this to the glorified body of Christe, according to these wordes. If I shalbe exalted, I wyll drawe al vnto me.

Saint Augustine (as he wryteth in his bookes, De ciuitate Dei) dyd marueyle that he sawe an iron moue it selfe vpon a vessel, by mouing the Lode stone vnder the vessel.

It is called Magnes, because the inuentour, or fynder therof, was so named: who (as Plinie wryteth) keepyng cattel in Easte India, had his shoes soled with plates of iron, and iron nayles, suche as they vse in Gascoyne, and had in his hande a staffe with a pyke, or hooke of iron: and restyng hym selfe vpon a quantitie of this stone, could not remoue his feete, neyther lyft vp his staffe. Then staying a whyle astonished, as ignorant of the cause, at the length began to perceiue the propertie of the stone, and to vnderstande the attractiue vertue thereof (the colour of it differeth not from iron) and was therefore called quicke iron, or lyuing iron.

Why the Lode stone was called Magnes, & the findyng thereof.

The

Sundry kindes of the lode stone.

The best kynde of these stones, is of Auzurine or blew colour, as the sea sometymes appeareth.

Of these, are found fyue kyndes or differences. The first is, of Ethiope. The seconde, of Macedonie. The thyrde, of Lechio in Boetia. The fourth, of Troad neare to Alexandria. And the fyfth of Asia: but at this day, it is founde in diuers other places. It is founde also in many places in Spayne: as in the hyll Morena, neare vnto the village of Calera, beyng of the order of saint Iames, in the prouince of Leon. Lykewise in a hyl of Moron, in the territorie of the Erle of Vrenia, is great quantitie thereof, and in diuers other places. The stone that we most commonly vse, is of the Ilande of Elua, of the Lord of Poinblina, whiche I iudge to be better then that of Denmarke. This and the other haue vertue to draw iron vnto them. And true it is that Teanxedes wryteth, that in Ethiope is founde an other kynde of this stone, that putteth iron from it. Auerroes the commentator of Aristotle, denyeth that Magnes draweth iron vnto it, but sayth, that iron by his naturall inclination, doth moue to the stone, as to his naturall place, by a certayne qualitie, whiche the stone impresseth in iron. And beside this vertue and propertie that it hath to drawe iron vnto it, it hath also another: and that is, that it geueth vnto iron vertue and power, to shewe the two poyntes of the Horizon, where it cutteth the Meridian, that is in the two wyndes, of North, and South. These vertues are founde more intent, in onely two partes of the stone: and these are euer opposite, or contrarie the one to the other, and so are they contrary in operation. For iron touched with the one part, and placed where it may moue freely, wyll shewe the North: and another iron touched with the other parte, wyll shewe the South. Fyndyng this experience, may be knowen, what part of the stone aunswereth to the North, whiche the Mariners call the face of the stone, and lykewyse of the South. This stone is so necessary, that without it, Nauigation shoulde be imperfecte and vncertayne, because it geueth lyfe to the needle and compasse, whiche leadeth and guydeth the Pilotte, that he maye goe certaynely

The lode stone of Spayne.

The Ilande of Elua.

The lode stone of Denmarke.

The lode stone of Ethiope.

Diuers opinions of the lode stone.

The qualities and properties of the lode stone.

The partes of the lode stone.

What parte of the stone aunswereth to the North and South.

in

ly in the day, and not erre or wander in the nyght. Also it sheweth and directeth to compasse the worlde, and to knowe the wyndes. And therefore, forasmuch as the compasse is so necessarie, we intende to shewe the order and manner howe it ought to be made, for it may chaunce to faile, or be lost in the viage. *The vse and making of the Mariners compasse.*

The .iiii. Chapter, of the making of the Mariners compasse for Nauigation.

TAke suche paste or paper, whereof Cardes are made, and make in it a Circle, of the quantitie of a spanne, or litle more or lesse. In the whiche you shal paynte the 32. windes, with theyr colours, in suche order as we gaue in the firste and seconde Chapter of the wyndes, and of the Carde, not forgettyng to marke the North with a floure deluce, and the East with a crosse. And more then this, may euery man garnyshe and beautifie the same, as seemeth best to his phantasie. Then on the lower or neather parte of this paste, you must drawe a lyne, which shalbe directly vnder that of the North and South, which shalbe the marke for the settyng of the Irons and Steeles. Then shal you take wyre of iron or steele, of the bygnesse of a great pynne, or accordyng to the bygnesse of the roundnesse of the paste, floure, rose, or flye, as it may be called. This wyre must be bowed double, so that euery of the partes may be equally as long as the Diameter of the flye, and a quarter part more. The endes or poyntes of these irons or steeles, must be pynched togeather, and made close, and open in the myddest, the one from the other, vntyll the endes come to be equal with the extremities of the Diameter of the flye, and so shal the steeles remayne in maner in fourme of an egge. These wyres or irons must be made fast in the

The floure deluce, and the crosse.

The flye, floure, or rose of the compasse.

The lyne of the North and South

the neather parte of the fyre: so that theyr extremities, endes, or poyntes, come precisely by the lyne of North and South. And to fixe or fasten them so, they must be couered with a thinne paper glued, leauyng the poyntes and endes vncouered: And these endes must be touched with the Lode stone, in this maner. The part that is vnder the floure deluce, must be rubbed on that part of the stone that answeareth to the North, as is sayde in the Chapter before. And this shal suffice for the perfection of the compasse, Yet some there be, that for superaboundaunce, doo touch the other part of the Iron, with that part of the stone that answeareth to the South, although it may suffice to touche it only with the other parte. This touchyng of the Iron with the stone, that the demonstratiue or wooryng vertue may shew it selfe foorth, must be done with geuyng certayne strokes with a hammer, on that parte of the stone wherewith the Iron muste be touched, that is to say, in the North part, or the South: And from these wyl come forth of the stone certayne beardes, lyke smal pricles, wheron you shal rubbe the point of the Iron, as you woulde whet a knyfe: and so shal certayne of those beardes of the stone, cleaue and sticke fast to the Iron. And the Irons thus touched, with the beardes cleauyng to them, you must take a pricke or poynt of laton of Piramidal, sharpe, or steple fourme, which is brode below, & sharp aboue toward the point, this is made rounde, or eyght square, as semeth best: and in the neather parte or breadth, it must be bored (but not through) with a borer, which must also be of Piramidall fourme, and enter into the myddest of the sayde Piramidall pricke or poynt of laton, vnto the myddest, or somewhat more. This Piramidall poynt (which the mariners cal the Capitell) muste be of heyght halfe a fynger breadth, or accordyng as the compasse shalbe, and muste be put through the center of the fyre, so that the poynt come foorth on the bygher part thereof. and must there be made fast, and wel fixte. Then shall you take a rounde boxe of wood, within the whiche the needle may be, not touchyng the sydes of the same: And this muste be of the heyght of

The touching of the needle with the lode stone.

The breaking of the stone, to drawe out his vertue.

The boxe of the compasse.

the

the halfe Diameter of the compasse. And ỳ ground or bottome thereof must be set to it, as the couerynge of a boxe, that it may be easely taken of, and put on, to haue often recourse, to touche the irons with the stone (which they cal feeding) when neede shalbe, that the vertue of the compasse fayle not. Also in the myddest of the grounde, or flooze of the boxe, you must set a sharpe poynt or pryncke, made of a wyre of laton, this must stand vpright vp, and vpon the pricke or poynt therof, you shal set the boxed hole of the Capitel, and that the wynde enter not aboue, you shal couer the boxe with a glasse. And thus beyng touched with the stone, and set vpon the poynt, it shal shewe the true part of the North, and consequently al the other wyndes.

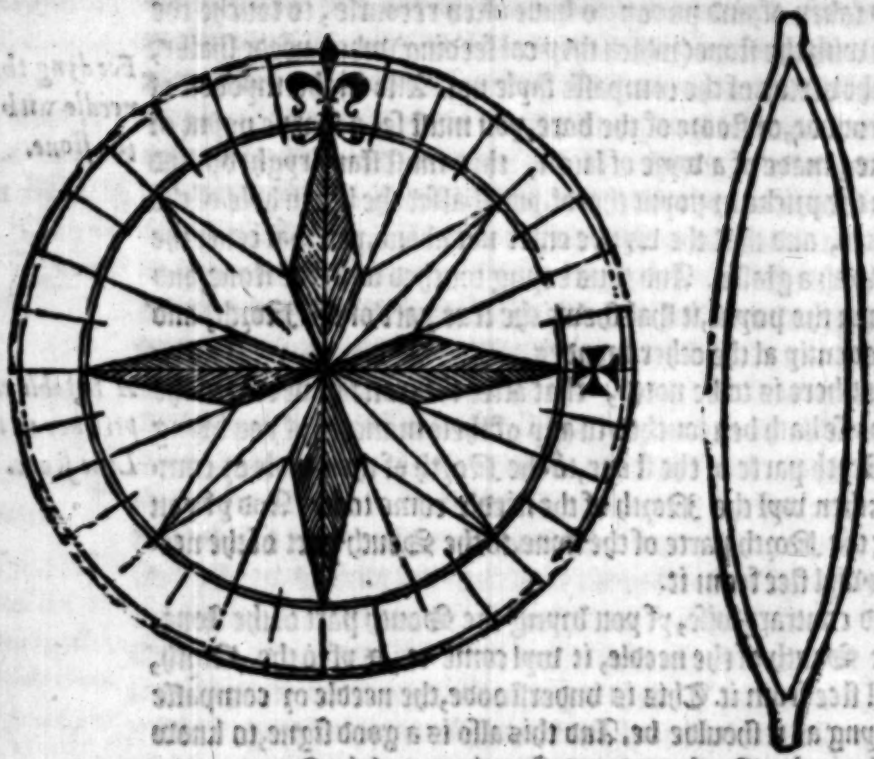
Feedyng the needle with the stone.

And here is to be noted, that after the irons or needle of the compasse hath ben touched in any of these maners, yf you bryng the North parte of the stone, to the North of the needle or compasse: then wyl the North of the needle come to it. And yf you bring the North parte of the stone, to the South part of the needle, it wyl flee from it.

A notable experience of the Lode stone.

And contrarywise, yf you bryng the South part of the stone, to the South of the needle, it wyl come it, & yf to the North, it wyl flee from it. This is vnderstoode, the needle or compasse standyng as it shoulde be. And this also is a good signe, to know whiche is the North parte and South part of the stone.

Moreouer this boxe must be put within another boxe, in the which it must hang vpon two circles of laton, annexed the one within the other: whiche serue that the compasse sway not, or hang not towarde the one syde or the other, although the shyppe sway, and this boxe also must haue his couer of wood, to keepe the other. You shall lykewyse obserue that the poynt of the Capitell, and the hole thereof, and also the poynt or pricke vpon the whiche it resteth, be vpryght, and lykewyse the Role, that it decline not to one part or other. And if it be quicker then it ought to be, then make the poynt that it goeth vpon somewhat blunter.



The.v. Chapter of the effect or propertie, that the compasse hath to Northeasting or Northwesting, whereby is knowen the variation of the compasse.

The variation of the compasse.

MANY and diuers are the opinions that I haue heard, and also read in certayne writers of later dayes, as touching the Northeastyng, and Northwestyng of the compasse, and yet me seemeth that none dooth touche the pyncke, and fewe the whyte. They call it Northeastyng, when the needle

Needle sheweth or poynteth from the north (whiche is his true marke) towarde the Northeast and Northwesting, when from the North, it declineth towarde Northwest. For the better vnderstandyng of these differences, whereby the needles differ or varie from the pole, you muste (beyng in the Meridian where the compasse shewe the pole) imagine a poynt vnder the pole of the worlde, and this poynt to be without all the heauens, conteyned vnder the fyrst moueable. The whiche poynt or part of heauen, hath a vertue attractiue, that draweth vnto it iron touched with the part of the lode stone, correspondent to that certayne part of heauen imagined without or vnder all ꝑ heauens, moued by the fyrst moueable. For yf it were imagined to be moued within any of the moued heauens, then the attractiue poynt, by the mouing of the fyrst moueable, & consequently the compasse, should make the selfe same mouing in 24. houres: which is neuer seene. And therefore this poynt is not in the moueable heauens, neither in the pole. For if it were in it, the cõpasse should not vary, Northeasting, and Northwesting. Therfore the cause of Northeasting or Northwesting, or departyng from the pole of the worlde, is, that being in the sayde Meridian, the attractiue point and the pole, are in the selfe same, or in one Meridian: and the compasse shewing the attractiue poynt, sheweth directly the pole. And departyng from the same Meridian towarde the East (the worlde being round) the pole of the worlde remayneth to vs on the left hande: and the point of the attractiue vertue, shalbe on the right hande, which is toward the Northeast winde. And in how much more we shal sayle toward the East, the distaunce shall appeare greater vnto vs, vntyl we come vnto the .90. degrees: and there shalbe the most and greatest Northeasting. And passyng from thence further forward, it shal appeare vnto vs, that ꝑ attractiue point, commeth nearer & nearer vnto the Meridian lyne: and so much that the compasse goe bettering or amending the Northeasting, vntil it returne to the selfe same Meridian in the oppolite or contrary part from whence they came, or where they began, & then that the attractiue point be to them directly vpõ, or against the pole of the worlde, & the compasse shal shew or point directly towarde it. And againe, passyng further forward, the pole of the

The poynt attractiue imagined vnder the pole of the worlde.

The cause of the variation of the compas.

Departing of the pole from the pointe attractiue.

The greatest Northeasting

worlde shal remaine to the right hande, and the point attractiue to the left hande, and so shal the compasse begin Northwesting, increasing it vntyl it come from thence to the. 90. degrees, & there shalbe the most of his Northwesting. For turning towarde the Meridian from the attractiue poynt, it shal go amending or bettring, vntyl it returne to the selfe same Meridian from whence it departed, and there shal the compasse shew the pole of the worlde directly, by, or ouer agaynst the attractiue poynt, whiche is perpendicularly vnder ỳ pole. And yf frō thence they should turne, to passe toward the West, the pole should rest to the right hand, and the attractiue point to the left, & so shal ỳ variation be to the Northwest: and this is the cause of the northeastyng, & Northwesting, or variation of the compasse. Also it is not to be vnderstoode that this Northeasting, & Northwesting, is vniforme, as is the departing (or accordyng to the departure) from the Meridain, where the compasse sheweth perfectly: but rather before at the beginning of the departing from the saide Meridian, it maketh difference, or variatiō in a certaine quantitie, & the increase that is afterward, is litle, and so much the lesse, in how much the more the departing is frō the said Meridian. For it is a passion of the circles, deuiding or cutting them selues in ỳ sphere: so that these differences are, as are they of the declinations of the Sun: which neare vnto the Equinoctials, are great, & neare to the solstitials, are litle. All the which shal euidently appeare in ỳ figure folowing, which is a circle deuided by two Diameters, into. 4. equal partes, cutting them selues in ỳ center in right angles. And from the center point (called the pole) cōmeth forth a moueable Meridian: & in it goeth a compasse likewise moueable about the circle. The attractiue point is somwhat distant from the pole of the worlde, & from it, commeth forth a threede, which must euer passe by the North & South of the compasse. And the compasse being in the Meridian of ỳ point attractiue, that passeth by the pole, shal shew the pole. And without that, shal go northeasting, or northwesting, so varyng & departing frō the true Meridian that commeth forth of the pole of the worlde. It is the opinion of some maryners, ỳ the Meridian where the compasse sheweth directly the pole, passeth by the Iland of Sancta Maria, and other say, by the Iland of Cueruo in the Asores. De-

The greatest northwesting.

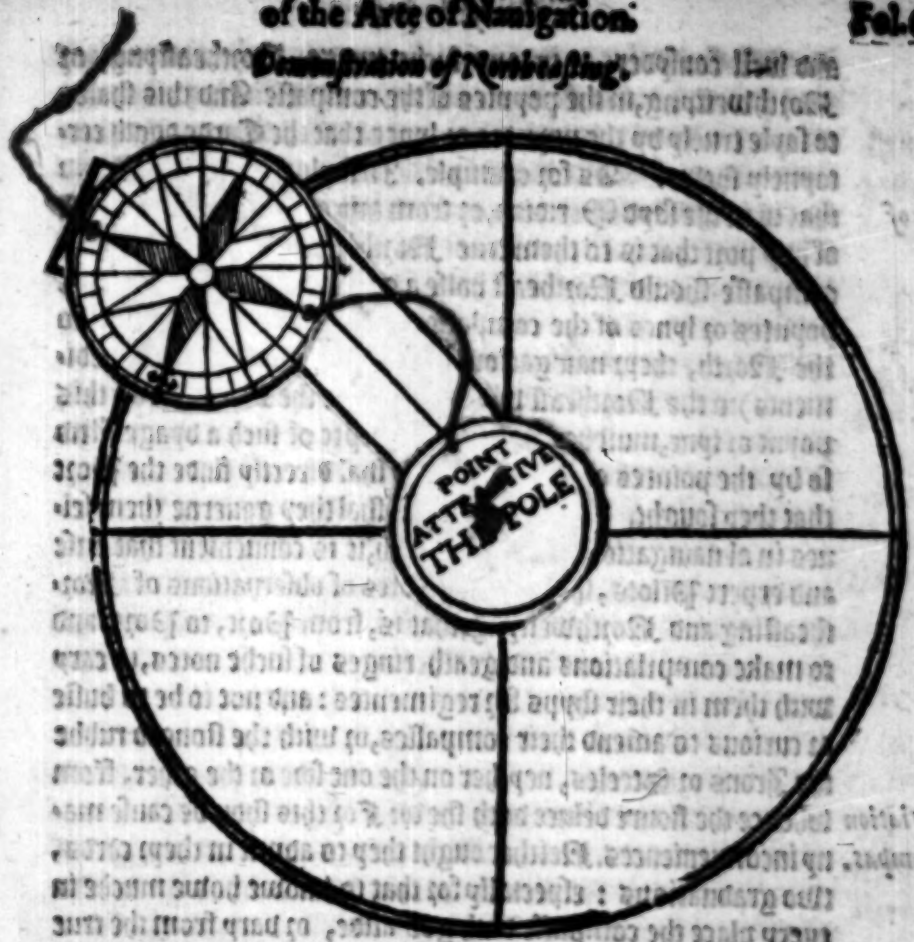
The attractiue point is vnder the pole.

The Northeastyng and Northwesting is not vniforme.

The declination of the Sun.

The meridian that sheweth the pole.

Demonstration of Northeasting.



And where as the inconuenience is manifest and notorious, the same must be remedied with prudence and tyme, and not to be negligent in the viage: but euer to vse & obserue experience, more profitable they the subtyle and curious questions of the secrete searchers of natural thinges without experience, wherof reason taketh his principall grounde. And therefore the wyse Pilot ought to knowe by experience, (as many of them doo not) howe muche a good compasse doth vary, Northeasting, or Northwesting from one Point to another, that to knowe howe muche the compasse doth vary, Northeasting, or Northwesting, from one place to an other (as to say, half a quarter, or more or lesse in quantitie as they are distant from the sayd Meridian, where the compasses shewe the Pole) shal in the nauigation take heede,

Experience, the ground of reason.

Aduertisment to Pilotes.

and well consyder in any suche vyage, Northeastyng, or Northwestyng, in the poyntes of the compasse. And this shalbe to sayle truely by the poyntes or lynes that the Carde dooth certaynely shewe. As for example. In sayling from any Iland that is in the sayd Meridian, or from any other part, in seekyng of any port that is to them true Northeast, yf by this way the compasse should Northeast halfe a quarter, then sayling by the poyntes or lynes of the compasse Northeast halfe a quarter to the North, they nauigation shalbe (excepting other impediments) to the Northeast which the Carde sheweth: And by this poynt or lyne, must be made the accompte of such a vyage. And so by the pointes of the Carde, they shal directly finde the Port that they sought. And by this order shal they gouerne themselues in al nauigations. For the which, it is conuenient that wise and expert Pilots, should make notes of obseruations of Northeastyng and Northwestyng, that is, from Port, to Port, and to make compilations and gatherynges of suche notes, to carry with them in their shyps for regimentes: and not to be to busie or curious to amend their compasses, or with the stone to rubbe the Irons or Steeles, neyther on the one side or the other, from whence the floure deluce doth shewe: For this shoulde cause many inconueniences. Neither ought they to admit in they cards, two graduations: especially for that to knowe howe muche in euery place the compasse doth goe aside, or vary from the true Meridian, may easily be made an instrument to shewe the same by the Sonne in the day, and by the starres in the nyght.

Example of sayling.

The variation of the compas.

The.vj. Chapter of the introduction and principles of the Art of Nauigation.

FOr as muche as now we haue the guyde, whiche is the compasse, it is conuenient to enter into the way, whiche is Nauigation. The whiche (as we haue sayde) is to go or passe by water from one place to another. And this presupposed, I say that he

he that desireth to attempt Nauigations, must know two thinges, which the Carde shal shew him. The one is, by what point or lyne he ought to sayle: and this shall the lynes of the sayling Carde shewe hym. The other is, the leagues of the distaunce, and this shal the scale or trunke of the leagues shewe, takyng with a compasse the distaunce of two places, and applyng it to the scale. The knowledge of these two thinges, ought the Pilot to beare in memory: and to put them in effect, ought to direct his foye shippe to the selfe same winde, which the compasse doth shewe. For the distaunce, he ought to knowe howe muche the shyppe goeth dayly, wel considering and obseruing the windes, tydes, currentes, and all suche thinges as may be with hym, or agaynst hym. And accordyng hereunto, he shal knowe howe muche he hath gone, and what remaynerh for hym to goe, and whether he be farre of, or neare vnto the place whither he intendeth to sayle: the which in Nauigation, is the ende desired. And because this estimation or computation can not be iust & exact, especially in a long vyage, or in long tyme, it shalbe conuenient that we rectifie or amend it, knowing the place where the shyp is, on the superficial part of the water, by the place that aunswereth to it in heauen. This place of heauen, is knowen by the altitude of the pole: and by the altitude of the pole, is knowen the altitude of the Equinoctial: & by the altitude of the Equinoctial and declination of the sunne, is knowen the Meridian altitude: and contrarywise, knowyng the Meridian altitude and declination of the Sunne, is knowen the altitude of the Equinoctiall, and by the Equinoctial, the pole, and by the altitude of the pole, is knowen the lattitude: and this is the place that is desyred to be knowen. But for as muche as the heauen is moueable from the East to the West, this place is not knowen as a certayne point, but is knowen as a lyne or paralel at a certayne distaunce from the Equinoctiall, and it is knowen in what poynt of this paralel the Shyppe is, by the altitudes that are taken from heauen: but it is knowen by the lyne that the shyp hath gone, as we wil further declare in the .xiii. Chapter, of making a point or pricke in the Carde. And in this maner you shal haue rectified the way that the shyp hath gone, and consequently the way

In Nauigatiō what is chiefly to be considered.

The distance.

The altitude of the pole and Equinoctial.

The meridian altitude.

To knowe the place of heauē

To knowe the way of the

 vyage.

that it hath yet to goe.

Rules to knowe the altitudes. And forasmuche as these altitudes are so profitable and necessarie, it shalbe needeful to geue rules howe we may vse them to our most commoditie. And for this, is presupposed to know, that al places situate on the superficiall parte of the earth, and water, eyther they are vnder one Meridian, so that they haue, or where they haue one selfe same longitude, and differ in latitude, or are in one paralel, where they haue one selfe same latitude, and differ in longitude, or are in diuers Meridians and paraleles, where they differ in longitude, and latitude. And I say, that if they haue one self same longitude, they saile from the one to the other, by the lyne of North, and South, and howe many degrees doth vary the altitude of the pole and of the Equinoctial in heauen, so many degrees haue they gone by sea, or by land. If two places haue one selfe same latitude, they passe from the one to the other by the lyne of East and West. And in such maner of vyage, the altitudes do not profite vs, because there is no variation. If they differ or vary in longitude, and latitude, they sayle from the one to the other by some of the other lynes. But there are more degrees that corresponde the way that the shyp maketh, then the degrees that vary the altitudes of the Equinoctial, and the pole. And this difference shalbe greater, in how much the lyne shal draw neare to East and West: And how much it shal draw neare to North and South, it shal be lesse. Of the degrees or leagues that answere to euery degree of the variation of the altitude, we wyl entreate hereafter in the. xii. Chapter.

Longitude & latitude.

Variation of degrees.

Howe the altitudes are knowen. These altitudes are knowen many wayes, but especially by two: as by the Meridian altitude and declination of the Sun (as we haue sayde) is knowen the altitude of the Equinoctial, and by it, the altitude of the Pole. The seconde way, they are knowen by the altitude of some fixt Starre, of those that are not hydde. And among many other, the North Starre is taken, because it is nearest to the Pole. To know the altitudes by the Sun, three thinges are necessarie, that is to say, an instrument, the declination of the Sun, and rules. The instrument to know the Meridian altitude, shalbe the Astrolabie, because it is moste com-

The fixte Starres.

The North Starre.

To knowe the altitudes by the Sunne.

The Meridian altitude.

commodious for this purpose, whereof we wyl entreate in the Chapter folowing. The declination of the Sunne (which is to take it away, or to ioine it with the Meridian altitude) we haue alredy described in the thirde Chapter of the seconde part. The rule to know when the declinations muste be ioyned with the Meridian altitude, or taken from it, we wyl geue in the. viii. Chapter. To knowe the altitudes of the Pole, by the altitudes of the North starre, two thinges are necessarie: that is, an instrument, and rules. The instrument wherewith the Mariners are accustomed to take the altitudes of the North, they cal Balestilia, which is a crosse staffe, whereof we wyl write hereafter in the nienth Chapter. And the rules of the Turne or compasse, whiche the North star maketh about the Pole, we wyl declare in the.x. Chapter.

The declination of the Sunne.

The altitudes of the Pole.

Iacobes staffe.

The.vij. Chapter, of the making and vse of the Astrolabie, with the which the Mariners take the altitude of the Sunne.

TAke a plate of copper, or laton (which for this purpose is better then any other mettal) of the bygnesse that you desire to make the Astrolabie, and is commonly of the bygnesse of a spanne of the Diameter, & let it be of the thicknesse of halfe a fynger at the leaste: for the waygh tier that it shalbe, so muche shall it be more steadie to take the altitude. This plate must be made rounde by a circle, leauyng commyng fourth of the circle or corner, in the which you shal put a ring or handle with a hole, whereby you may hang the Astrolabie, by a threede or lyne to take the altitude.

After it is thus made, with the ryng or handle annexed thereto, make it bryght, and smoothe, pullyshed on both the sydes, and all of one equall thicknesse, that one syde be not heauier then another, which you shal trie in this maner: hang the plate by the ryng or hole that you haue made, and from the same hole hang a plomet of leade, salted to a heere, or fine threede of silke. The Astrolabie thus hangyng, free, and at libertie with the plomet, if then the threed fal vpon the center of the Astrolabie, it is wel: but yf the threede doo leane or swarue to the one syde, or to the other, from the center, then is that side thicker and heauier then the other, and muste therfore be made thynner, vntyl the threede fall iustly vpon the center. This doone, make a circle vpon the sayd center, a litle within the circumference of the Astrolabie. Then draw a Diameter from the center of the hole, in the which the ring or handle is, vnto the center of the Astrolabie, trauersing or ouerthwartyng the whole Circle. And this shalbe called the lyne of the zenith, or Vertical poynt: which also shalbe cut with an other Diameter vpon the center, making right angles with it. And this Diameter shalbe called the Horizontal line. These two Diameters shal deuide the circle into foure equal partes. After this, you shall make another circle, so muche more within the second, that betwene the circumferences of both the circles, may be conteyned the numbers of the degrees. Then (the Astrolabie hangyng before you) you shall deuide the one part (beyng the superiour and least part) fyrst into three equall partes, and euery part shal conteyne. 30. degrees. Then shall you deuide euery part of these into three other equal partes, and they shall conteyne. 10. degrees: and euery of these deuide into two partes, and they shall conteyne. 5. degrees. This doone, put a ruler vppon the center of the Astrolabie, applying it to euery of the poyntes that deuide the sayde partes, and draw certayne lynes that passe from the circumference of the first circle, vnto the lesse circumference: and in the spaces of the lesse circle write the numbers of the degrees, beginning in the Horizontal lyne: and in that space put fiue, and in the seconde, ten, and so forth of the other, vntyl the. 90. degrees ende in the lyne of the zenith: then shall you deuide the spaces that are betwene the fyrst circle

The rectifiyng of the Astrolabie.

The threede and plomet.

The lynes vertical & horizontal.

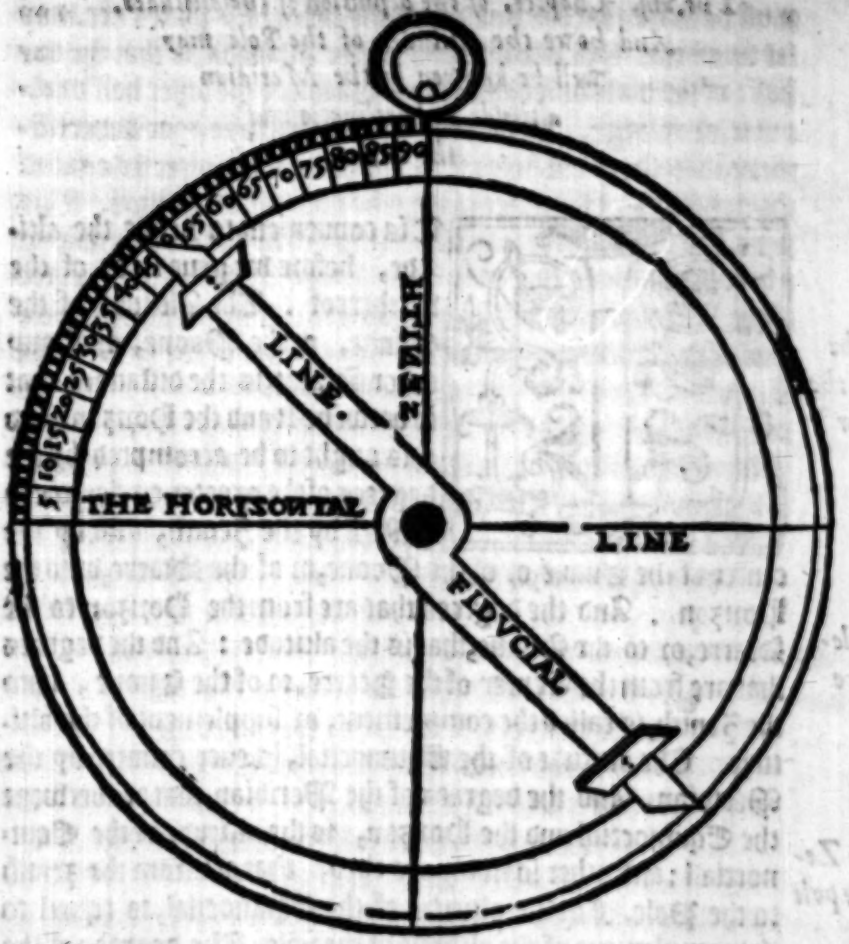
and

and the seconde, euery space into fyue, whiche shal make the. 90 degrees. The Astrolabie thus made, you shal make the Alhidada or Label. For the whiche, you shall take a plate of laton, of the breadth of scarcely two fingers, and as thicke as the Astrolabie: also as long as the Diameter of the Astrolabie, and make a lyne in the myddest therof by the longitude: in the middest of this lyne, make a circle, so great that it may touche in the sides of the plate: then cut of this plate on the one syde, that whiche it hath from the lyne to the ryght hande, and on the other syde, that that it hath frō the line to the leaft hand, leauyng the circle whole. This lyne that shal passe by the center of the circle, is called Linea fiduciæ. (that is) the lyne of confidence, whiche is that, that sheweth in the degrees, the altitude that is taken. Then shal you take away the endes or corners of the Alhidada that are without the lyne, so that you touche not the lyne. This done, you shal make two litle rysyng or rayled tablets or plates, of the same metal wherof the Astrolabie is made, and of the self same thycknesse that is the Alhidada, or litle lesse, and of the breadth of the Diameter of the circle of the Alhidada, and let them be a thumbe in height or breadth. In the myddest of these two places, by the height, you shal make a line. When these are made equal, and al they angles right, in euery lyne of these that you haue made, you shal also make two holes, equally distaunt from the sydes or edges of the sayde plates or tablettes. And of the two holes of euery of these litle plates, the one hole must be as bygge as may conteyne a great pynne: and these shal serue to take the altitude of the Starres. The other must be so subtile and smal as a fine sowyng needle: and these serue to take the altitude of the Sunne. They must be made in such maner, that the outwarde parte of them be bygger, and lesse within of the quantitie that I haue sayde. These tablets or erected plates beyng thus made, they must be sothered in the Alhidada, betwene the center and extremities or ends of the same, making in it certayne notches where they may be made faste, and sothered: or leauyng fyttes in the plates certayne sharpe poyntes or corners, that may enter into certaine holes made in the Alhidada, whereby they may be made fast vnderneath with pinnes: And they

The Alhidada of the Astrolabie.

The holes of the Alhidada.

must be so set, that the line where the holes of ẏ plates are, may fal vpon the lyne of confidence of the Alhidada, so that the one halfe of the plate be set vpon the Alhidada, & the other half without it, or at large. In lyke maner you shal take good aduertisement, that the great hole of the one plate, stand directly against the great hole of the other plate, & be nothing at al awrie. This done, you shal bore the Astrolabie through by the center, making a very rounde hole, that may haue in the middest of it the center of the Astrolabie. This hole shalbe of the biggenesse of a goose quyl. And the like shal you make in the center of the circle of the Alhidada. Then shal you make a pynne or nayle of the same laton, the whiche on the vpper part of the Alhidada may haue a playne and rounde head. This pynne also shalbe very rounde and smooth, that it may enter iust and close into the hole of the Alhidada and Astrolabie. And at the ende or poynt therof, comming forth on the other side of the Astrolabie, must be a hole made sydeway through the pinne, close to the plate of the Astrolabie, of the byggenesse of a litle naile or pinne, that may be put therein, to make fast togeather the Alhidada with the Astrolabie, so that the Alhidada may thereby be turned round about ẏ Astrolabie, as appeareth in this figure folowyng.



To take the altitude of the Sunne, hang vp the Astrolabie by the ryng, and set the Alhidada against the Sunne, and rayse it, or put it downe in the quarter that is graduate, vntil the beames of the Sunne enter in by the litle hole of the other tablet or raysed plate, and precisely by the other litle hole of the other tablet. Then loke vpon the lyne of confidence: and how many degrees it sheweth in the quarter that is graduate (beginnyng from the Horizontal lyne) so many degrees of height hath the sunne. In lyke maner shal you doo to take the altitude of any other Star, lookyng through the great holes, because this may hardly be seene by the litle holes.

To take the altitude of the Sunne.

The

The.viij. Chapter. of the definition of the altitudes. And howe the altitudes of the Pole may well be knowen by the Meridian altitude and declination of the Sunne.

What is the altitude of the planettes or starres.

IT is conuenient to define the altitude, before we geue rules of the vse thereof. The Altitude of the Sunne, or the Moone, or of any other Starre, is the distaunce that is betweene it and the Horizon. And this ought to be accompted by the degrees of the greater circle, which passeth by the Zenith, and by the center of the Sunne, or of the Moone, or of the Starre, vnto the Horizon. And the degrees that are from the Horizon to the Starre, or to the Sunne, that is the altitude: And the degrees that are from the Center of the Starre, or of the Sunne, vnto the Zenith, is called the complement, or supplement of the altitude. The altitude of the Equinoctial, is euer counted by the Meridian. And the degrees of the Meridian, that are betwene the Equinoctial and the Horizon, is the altitude of the Equinoctiall: and other so many are they, that are from the zenith to the Pole. For the altitude of the Equinoctial, is equall to the complement of the altitude of the pole. The degrees of the Meridian that are betwene the Equinoctiall, and the zenith, is called the complement of the altitude of the Equinoctial, and is equal to the altitude of the Pole. And although we haue defined the altitude in general, yet shall we onely profite our selues by the Meridional altitude of the Sunne. The Meridian altitude, is the greatest altitude that the Sun hath euery day: and this shalbe, when the Center of the Sunne is in the Meridian. And the Arke of the Meridian, that is betweene the Horizon and the Sunne, is the Meridian altitude. So that when we say the altitude of the sunne is taken, it is vnderstoode at midday. The shadowes that the Sunne then maketh, are in three sortes.

The complement of the altitude.

From the Zenith to the pole

The Meridian altitude of the sunne.

The shadowes that the sunne maketh at midday.

For

For either to vs it casteth the shadow toward the North parte or toward the South, perpendicular by a right lyne, so that at mydday, or none, nothyng that standeth vpryght, geueth any shadow at al. But forasmuch as there is such variation in declinations, altitudes, shadowes, and paralelles, it shalbe necessarie to geue rules for al variations. And these shalbe reduced into some briefe and compendious rules, the which I haue here described, that the wyttie may take profite by them, and the rude learne them not caryng for the rules of the Mayners, because they are to long and tedious. For (as the Philosopher sayeth) it is vainely doone by many, that may well be doone by fewe.

Rules for all variations.

The perpendiculer shadow.

When the shadowe shalbe perpendiculer, it is because the Sunne is in the Zenith, & 90. degrees aboue the Horizon. And then how many degrees of declination the Sunne hath, so much shal we be distant from the Equinoctial, toward the part where the Sunne declineth. And if it haue no declination, it and we shalbe vnder the Equinoctiall.

The declining shadowes.

But when the sunne and the shadowes shalbe to vs from the Equinoctiall toward one of the Poles, we shall take away the declination from the meridian altitude, and then shall remayne the complement of the elevation, which complement beyng taken from 90. degrees, then shal remayne that whiche we be distaunt from the Equinoctial, toward the same Pole.

When the Sunne declineth from the Equinoctial, toward the one Pole, and the shadowes shalbe towarde the other, we shal ioyne the declination with the Meridian altitude: and yf al come not to 90. then substract them from 90. degrees, and we shal haue the complement, and so much shal we be distaut from the Equinoctial, towarde that Pole to the whiche the shadowe falleth. And if they be more in number then 90. then the ouerplus of 90. shal we be distaunt from the Equinoctiall, towarde the Pole where the sunne declineth. And if they be iust 90. we shalbe vnder the Equinoctial.

When the Sunne hath no declination.

When the Sunne hath no declination, we shalbe distaunt from the Equinoctial the complement of the Meridian altitude, towarde the Pole where the shadowes are. By these rules (before the vse whereof we haue spoken) may be knowen how much

is

is the greatest declination of the Sunne, the altitude of the Equinoctial, the day, houre, and minute, when the Equinox was: the which is knowen as foloweth.

To knowe the greatest declination of the Sunne.

Hauyng taken the greater Meridian altitude of the Sommer (whiche is in the beginning of Cancer) & the lesse of Winter (which is in the beginning of Capricorne) taking away the lesse from the more, the rest is that, that is from Tropyke to Tropyke, & consequently parted by the myddest, is the greatest declination. As for example. I suppose, that being in the Citie of Cadiz, to finde the greater Meridian altitude of the Sun (beyng in the beginnyng of Cancer) to be. 77. degrees, and the lesser Meridian altitude (whiche is, when the Sunne is in the beggynnyng of Capricorne) to be. 30. degrees: then takyng. 30. from. 77. remayns. 28. degrees: and so much is from Tropike to Tropike. And the halfe (which is. 23. and a halfe) is the greatest declination.

Example.

Consequently the greater declination added to the lesse Meridian altitude, or takyng it away from the greater Meridian altitude, that ryseth thereof, is the altitude of the Equinoctiall. Example. 23. and a halfe of the greatest declination, ioined with 30. of the least meridian altitude, or taken away from the. 77. of the greatest Meridian altitude, remaine. 53. degrees and a half, which is the altitude of the Equinoctial, in the Citie of Cadiz. Wherevpon it foloweth, that when we shal take the meridian altitude in. 53. degrees and a halfe, that day is the true Equinoctial. But if it had one day lesse, and the other day folowyng it had more, we must take the lesse from the more, & fourme the rule of three vppon the rest, sayyng, If. 24. minutes (which is that that the Sun declineth in one day) doth yeelde. 24. houres, how much shal those minutes that lacketh of. 53. degrees and a halfe of the altitude of the Equinoctial, yeelde me? Multiplyng & deuiding according to the foresayde rule, then that which commeth thereof, shalbe the houres after the midday, when it is Equinox.

Example.

The true Equinoctial.

Example of the experience that I made in the Citie of Cadiz the tenth day of March at midday by high noone. I toke the altitude of the Sunne, in. 53. degrees, and. 26. minutes, they lacke to be the Equinoctial. 4. minutes. In other day, the. 21. of

Marche, at noone, I tooke the Sunne in 53 degrees, and fifte minutes: whiche are more then the Equinoctial by twentie minutes. Then to knowe at what houre the Sunne was in the 53 degrees, and thirtie minutes of the Equinoctial, I tooke away the Meridian altitude that I tooke at the tenth of March, from that that I tooke at the eleuenth, which is the difference 24 minutes, & I formed the rule, saying: if 24 minutes the Sunne dyd ryse to me, in 24 houres, then in howe much time shall rise vnto me the foure minutes that failed me at the tenth of march? I multiplied, deuided, and found, that in foure houres; and so shal you say, that the Equinoctial was in the citie of Cadiz the tenth day of Marche, at foure of the clocke at after noone, whiche is vnderstoode (according to the Astronomers) at foure houres run at the eleuenth day of March, at this present yeere. 1545.

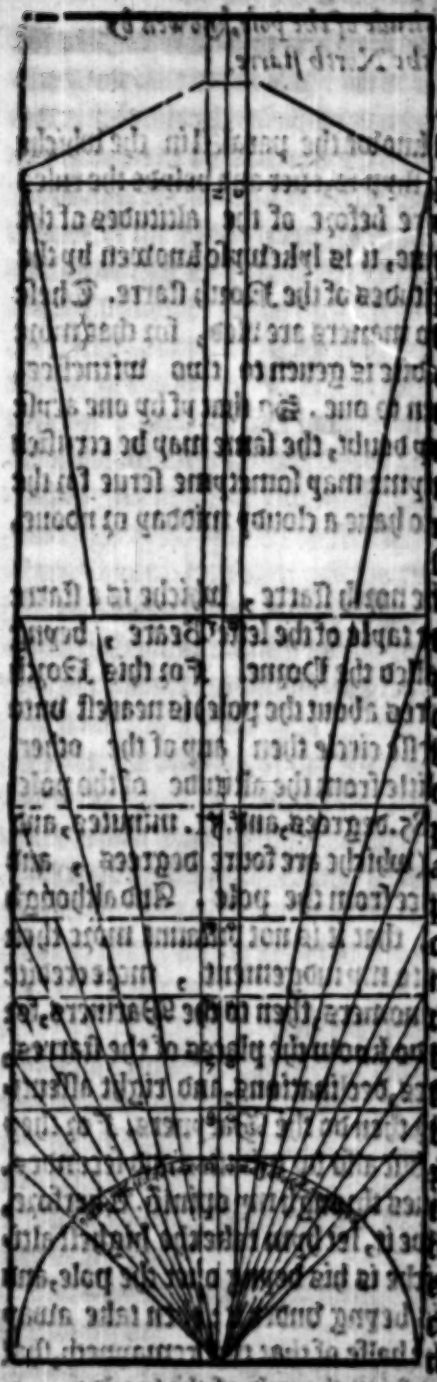
The. ix. Chapter. of the making of the crosse staffe, wherewith the Mariners take the altitude of the North Starre.

MAke a square staffe or yarde, of the thicknesse of a finger, more or lesse, accordyng to the goodnesse of the wood, and of length fire spannes, or more. For the longer that it is, the more precyse shall it be, and the degrees shalbe the greater, whereby foloweth the certaintie of the altitude. Then take a very plaine table, of the length of the staffe, and two spannes of breath, or at the leaste a spanne and a halfe: and in the myddest of this Table, make a ryght line by longitude, and in the one ende of this lyne, make another lyne that may cut it in ryght angles. And vpon the cuttyng of these two lynes, put the foote of the compasse, and make halfe a circle, whiche may remayne on the parte of the long lyne, so that the halfe circle may haue so muche Diameter, as you desire the

height

heyght of the hammer, head, or crossepeece of the staffe to be. This halfe circle being made, you shal drawe two lynes, equidistaunt to the lyne whiche you haue made by the middest of the Table. These lines must touch in the extremities or ends of the halfe circle. Then deuide euery half of the halfe circle, or quarter of the circle, into two equal partes, & the two halfes that shal end in the first lyne, deuide eche of them into .90. equal partes. Then take a ruler, and put the edge therof vpon the center of the halfe circle, and vpon euery of the markes which deuide the .90. parts, and so proceede, makyng punctes in the lynes, whiche you haue made equidistaunt to the fyrst lyne. Then drawe certayne right lynes, from the punctes of the one lyne, to the opposite punctes of the other: and so shal the draught be ended. Then take ẏ staffe or yard, & put the one end therof in the center of the halfe circle, and apply the edge of the yarde to the lyne that gooeth by the myddest of the Table: and marke in the yard the markes that are in the sayde lyne, by meanes of the trauersing lynes, and see also that the markes which you make in the yard, be trauersyng lynes, and make them theyr numbers, beginning at the ende or poynt of the yarde that shalbe to the contrary part, from that whiche you dyd in the punct of the halfe circle. And to knowe with what degrees you shall beginne the yarde or staffe, and what number you shal marke in the fyrst lyne of the punct, looke howe many degrees are from the circle whiche you deuided betweene the lyne that goeth to the last marke, and with so many degrees enter, and so consequently shall you place the numbers from syue to syue, or from tenue to tenue. When you haue thus numbred the yard, then to make the crosse peece therof, take a table or planke of good wood, which shalbe so muche in length, as shalbe the Diameter of the half circle, & so muche in breadth as three tymes the thicknesse of the yarde, and of thycknesse two syngers, or litle lesse. On the one syde also it muste be very playne, and on the other syde in the middest it must haue a square or quadrature of al the thicknesse of the planke, and from the square to the endes, it must be made thynner and thynner, so that it haue in maner the fourme of suche pickars wherewith

mylstones



mistones are picked. And in the middest (by longitude and latitude) it must haue a square hole, by the whiche the yarde may enter iust, & make ryght angles with the crosse peece. And the poynt of the yarde must enter by ẏ playne syde of the crosse peece, and come foorth of the square syde therof. To take the altitude of the North starre, or any other starre on the sea (for it serueth not on the lande, nor for the sunne, except the sunne shalbe vnder any thinne cloude, and the Horizon cleare) you shall put the head of the staffe to the corner of your eye, raysing it vp, or puttyng it downe, vntyl the neather part of the crosse peece come with the Horizon: and beyng so, yf the hygher part of the crosse peece shall come with the starre, you must looke the playne side of the crosse peece in what number of degrees of the staffe it falleth, and those degrees shall be the altitude of the starre: as yf the crosse peece reache not to the starre, you must bryng the crosse peece neater to your eye, vntyl the one part thereof come with the Horizon, and the other with the starre, and the degrees whiche it sheweth, shalbe the altitude.

To take the altitude of the starres.

The.x. Chapter, of the altitude of the pole, knowen by the altitude of the North ſtarre.

TO knowe the paralell in the whiche the ſhyp is, ouer and beſyde the rules there before of the altitudes of the ſunne, it is lykewyſe knowen by the altitudes of the North ſtarre. Theſe two maners are vſed, for that more credite is geuen to two witneſſes, then to one. So that yf by one aryſe any doubt, the ſame may be certified by the other, and alſo becauſe tyme may ſometyme ſerue for the one, and not for the other as, to haue a cloudy mydday or noone, and a cleare nyght.

The North ſtarre. The leſſe Beare.

The altitude is taken of the north ſtarre, whiche is a ſtarre in the extremitie or ende of the taple of the leſſe Beare, beyng a conſtellation, commonly called the Horne. For this North ſtarre (of the moſt notable ſtarres about the pole) is neareſt vnto it, and ſhal therefore ſhewe a leſſe circle then any of the other, and ſo ſhal his altitude differ litle from the altitude of the pole.

The Horne. The diſtaunce of the North ſtarre from the Pole.

This ſtarre hath declination, 85. degrees, and. 51. minutes, and the complement to nientie (whiche are foure degrees, and nientie minutes) is his diſtaunce from the pole. And although the Mariners holde opinion, that it is not diſtaunt more then three degrees and a halfe, yet to my iudgement, more credite ought to be geuen to the Aſtronomers, then to the Mariners, for as much as the Aſtronomers do know the places of the ſtarres, with theyr longitudes, latitudes, declinations, and right aſſentions, more perfectly & preciſely then do the Maryners. For they accompt not only by degrees, but alſo by minutes and ſecondes. But let none deceiue them ſelues through my opinio. Therfore, whoſoeuer wyl preciſely knowe it, let hym take the highest altitude of the North ſtarre, whiche is his beyng ouer the pole, and the leſſe altitude, whiche is his beyng vnder it: then take away the leſſe from the more, and the halfe of that that remayneth, ſhal bee the diſtaunce of that ſtarre from the pole of the worlde.

And

And likewyse by this experience, may be knowen the altitude of the Pole, and what al the other starres, that goe not downe vnder the Horizon, be distaunt from it. Joyning the greater altitude with the lesse, and that shal amount thereof, deuided by the halfe, shalbe the altitude of the Pole: and takyng away this altitude of the Pole, from the greater altitude of the starre, or the lesse from the altitude of the Pole, the rest that remayneth, shalbe the distaunce of the starre from the Pole. And as the Pole is inuisible, it can not be seene or knowen, when the North starre is hygher or lower, except it be by the meane of some other marke: and for this is consydered the position of the former Guards, or watch, being one of the two starres called the Guard, whiche are in the mouth of the Horne. The Mariners haue noted eyght positions from the former Guard starre, to the North starre, which answeare to the eight principal wyndes. And as the guarde is to the North starre accordyng to the placyng of these positions, so shal it be higher or lower from the Pole. Let vs here put the common rules which the Maryners vse, to comply with those that are of opinion of the three degrees & a halfe. And for the opinion of the Astronomers (which is ẏ distance of 4. degrees, and 9. minutes) I wyl hereafter geue a circuler figure with a moueable horne: then the eyght wyndes of the eyght positions beyng marked, and puttyng the guard and the North starre in euery of the wyndes, it shalbe the distaunce that the North starre is hygher or lower from the Pole.

The pole is inuisible.

The two starres called the guardes of the North starre.

Common rules of the maryners, differing from the Astronomers.

Common Rules.

The former Guard being in the East, the North starre is in one degree and a halfe vnder the Pole.

The Guard being in the Northeast, the North starre is three degrees and a halfe vnder the Pole.

The Guarde beyng in the North, the starre is three degrees vnder the Pole.

The Guard in the Northwest, the starre is halfe a degree vnder the Pole.

The Guard in the West, the starre is one degree and a halfe aboue the Pole.

These rules after the mariners accompt do hold, but not after the astronomers accompt, as may appeare in the rules next before.

The Guard in the Southwest, the starre is three degrees & a halfe aboue the Pole.

The Guarde in the South, the starre is three degrees aboue the Pole.

The Guard in the Southeast, the sayd North starre is halfe a degree aboue the Pole.

The eyght principal wyndes according to foure lynes.

Note that these eyght wyndes, are made accordyng to foure lynes. Whereof two are ryght, whiche are North and South, & East and West: and the other two are crooked, which are Northeast Southwest, and Southeast Northwest. When ẏ Guarde and the North starre shalbe in the ryght lyne, it shal appeare cleare how they are: and when they shalbe in the crooked lynes, it may be seene, because the Guardes are the one by the other in a ryght lyne.

An instrument to knowe the rysing or fallyng of the North starre from the pole of the world.

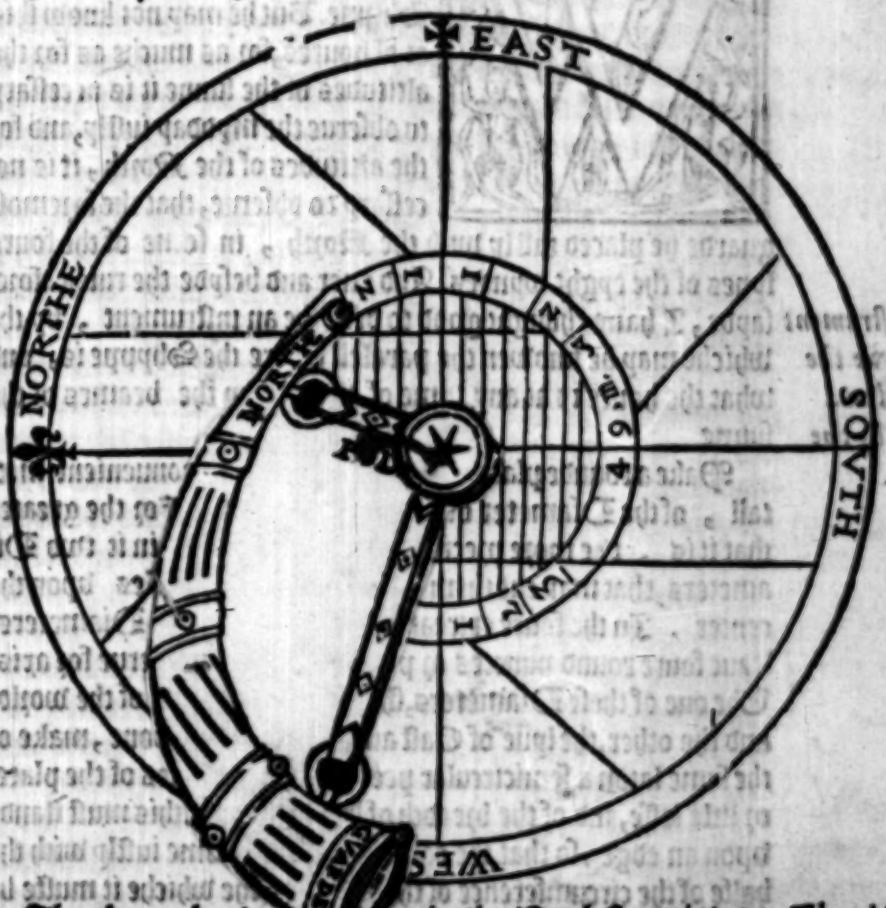
To see by Theorike or Speculation, how the North starre ryseth vp, and goeth downe from the Pole of the worlde, I wyll here describe the sayde circuler figure or instrument, whiche is a circle, in whose circumference are wrytten the eyght wyndes. The North in the highest place of the instrumēt, which they cal the head, and the South in the neather part thereof, whiche they cal the foote: the East in the ryght arme, the West in the leaft arme: the foure rest betweene these in their places. And here is to be noted, that the lines which passe not through the center, are of the windes of their equidistances that passe through the center. Within this circle, is an other litle circle, which describeth ẏ starre of the North, by the mouyng of the fyrst moueable, & hath for his center the pole of the worlde, as hath the fyrst. This litle circle hath for his Diametre eyght degrees and eyghtiene minutes: as foure degrees and nyne minutes aboue the pole, and the other foure degrees and nine minutes vnder it. And they are diuided by certayne lynes equidistant to the East and West. In ẏ center of this circle, is auered a horne, with his seuen starres, moueable rounde about by all the wyndes. And seeyng them in heauen how, & in what wynde they are, euen so in this figure shal we see the North starre, in what part it is of the degrees hygh or lowe from the pole: & that the Pylot or Mariners shal not erre, I say that he ought not to put the foreguarde in the wyndes that

The horne of the seuen starres.

Aduertisment to Maryners in vsing the figure folowing.

passe through the center of the figure, for it shalbe North and South with the pole, and not with the starre of the North, as it ought to be, and so of the other wyndes. And in this maner the starre of the North, shal shewe in the lynes equidistant from the lesse circle, the degrees & partes of degrees that it is hygher or lower then the pole of the world: for the same course, differences, and variations, it maketh in heauen.

This figure is after the Astronomers, which affirme that the North starre is foure degrees and nyene minutes from the pole.



Thus beyng knowen how muche the North starre is vnder or aboue the pole, let vs take the altitude thereof: and that of it that is vnder the pole, let vs ioyne to his heyght, and as muche of it as is aboue, let vs take away, and that shal ryse thereof, shal be the altitude of the pole aboue our Horizon.

The altitude of the pole aboue the Horizon.

The. xi. Chapter. of the compoſition and vſe of an inſtrument, by the whiche without obſerning the South Sunne, or midday, is knowen the altitude of the pole, and the houre that is.

I haue geuen rules, whereby the Pilotte may knowe in what paralel he fyndeth hym ſelfe with his Shippe. But he may not know this at al houres, for as muche as for the altitudes of the ſunne it is neceſſary to obſerue the myddap iuſtly, and for the altitudes of the North, it is neceſſary to obſerue, that the formoſt guarde be placed iuſtly with the North, in ſome of the foure lynes of the eyght wyndes. And ouer and beſyde the rules afore ſayde, I haue thought good to deſcribe an inſtrument, by the whiche may be knowen the paralell where the Shyppe is, and what the houre is at any tyme of the day by the beames of the ſunne.

An inſtrument to knowe the paralel and houre by the ſunne.

Make a rounde plate of Laton, or other conuenient mettall, of the Diameter of a ſpanne, or more. For the greater that it is, the more precyſe ſhal it be: and make in it two Diameters, that may cut them ſelues in ryght angles vpon the center. In the foure extreames or endes of theſe Diameters, leaue foure round punctes or poyntes, that may ſerue for axis. The one of theſe Diameters, ſhalbe called the axis of the world, and the other, the lyne of Eaſt and Weſt. This doone, make of the ſame laton a ſemicircular peece, of the thyckneſs of the plate, or litle leſſe, and of the breadth of halfe a fynger: this muſt ſtande vpon an edge, ſo that the conuex part may come iuſtly with the halfe of the circumference of the plate, to the whiche it muſte be nayled or ſothered in the neather part of the plate, the ſemicircle beyng rayſed, ſo that the endes therof may come with the endes of the axis of the world. And this ſemicircle ſhal you deuide into two equal partes, and euery halfe into. 90. degrees, begynnyng from

from the halfe poynt towarde the ende of the Axis of the worlde, whiche are the Poles.

In lyke maner shal you make two circuler peeces, of the bigneſſe of a peece of foure ryals of plate, whiche they cal rundels, for the houres: theſe muſt be made faſt in the plate by the Poles of the worlde, whiche may holde or beare them by their centers. And euery of theſe rundelles muſt be deuided into. 24. equall partes, and although not al, yet the vppermoſt part of the plate. And aboue in the higheſt point of theſe diuiſions, you muſt write 12. becauſe that there it ſhal ſhew the midday or noone. And frō thence, the afternoone houres muſt begyn their numbers towarde the Weſt part, and ſhal ende. 6. houres in the halfe or myddeſt of the ioynt of the circle with the plate. In the other ioynt of the other part, ſhal begyn. 6. of the houres before noone, & ſhal ende 12. in the hygheſt poynt. You muſt alſo make another Semicircular peece, of the breadth of a finger, this muſt be playne or flat, and the concauitie or holowneſſe thereof, equal to the Semicircle of the edge or ſyde of the plate, and in the endes muſte haue two holes, wherein may iuſtly enter the poyntes that come foorth of the circle, for the houres, whiche are the Poles of the worlde. Alſo, this Semicircle muſthaue two lynes, one on the vppermoſt part, and the other on the neathermoſt, which may deuide the breadth into two equal partes. This halfe circle lykewyſe muſt be deuided into two equal partes by longitude, with a trauerſed lyne, which ſhalbe called the Equinoctial, & from this lyne, to the inwarde part thereof, muſt be counted. 23. degrees and a halfe towarde the one part, and as muche towarde the other part of the. 90. that euery halfe of the circle conteyneth. And at euery part where ende the. 23. degrees & a halfe, make a trauerſed lyne, ſo that from the one to the other, may be. 47. degrees. And in this ſpace ſhall you drawe certayne lynes equidiſtaunte with them of the middeſt, that they and the myddle lyne, may deuide into. 4. equal partes the breadth of the halfe circle. Then looke in the table of the declinations of the ſunne, what declination haue the. 5. degrees of Aries, and that ſhal you accompt from the Equinoctiall towarde the one part, and

as muche more towarde the other, makyng a lyne that may trauerse that of the myddest, where that declination dooth ende and touch in the other two lynes. And the same shal you doo at. 10. 15. 20. 25. and 30. which is the ende of Aryes, and begynnyng of Taurus: & then the lyne shal trauerse al the breadth. The like also shal you doo to Taurus and Gemini, then in the spaces, wryte the caractes of the .xii. signes, begynnyng Aries from the Equinoctial, towarde the North Pole. And then doo Taurus and Gemini ende in the greatest declination, beginnyng Cancer in the other part of it. Then Leo and Virgo do ende in the Equinoctial, where shal begyn Libra, Scorpio, Sagittarius: and in the other parte, Capricornus, Aquarius, and Pisces, shall ende in the Equinoctial where Aries began. This halfe circle must haue an openyng, or open place, euen and iuste in the myddest from the Equinoctial, vnto somewhat more then the greatest declinations, and must be a litle broder on the inner part, then without, and not so brode as may come to the two lynes, because it woulde then take away the graduation of the signes. And in this open place must be put a square grayne or stubbe, whiche on the inner part may come playne with the halfe circle, & on the vtter part may come forth a litle, where shalbe nayled a square peece of Laton, of the breadth of the halfe circle. This graine or stubbe being so nayled with the peece, must haue in the middest a hole, so smal, as may receyue a litle pynne, and by the center of this hole, must passe a lyne, whiche shal trauerse all the grayne. And this lyne shal serue to put the sunne (whiche the hole representeth) in the degree of the signe where it is. This halfe circle where it goeth in the circumferences of the rundels for the houres, must be syled on the one side vnto the lyne that is in the myddest, to marke it, and shewe the number of it. For the placyng or settyng of this instrument, you must cut a gyrdle or ryng of laton, as thicke as the plate, and of the breadth of a fynger, or lytle, lesse: and so large, that of it may be made a circle somewhat bygger then the plate, so that the plate and the Meridian may easyly be contayned within it. This circle shalbe called the Horizon, which must be deuided into foure quarters.

The caracts of the .xii. signes.

The hole that representeth the Sunne.

The placyng or settyng of the instrument.

In lyke maner must be made two semicirculer peeces, & the

endes

endes of them muſt be nayled or ſothered in the poynts that deuide the quarters of the circle: and deuide the one from thother in two equal partes, making right ſpherical angles. And in this poynt of theſe two peeces, muſt be nayled or ſothered a Paſſel, the which at the one ende is druided into two braunches or forkes. Then ſhal you make a baſe or foote for the ſame, whiche in the vppermoſt part thereof, ſhal haue a concauitie or holownelle, where may be ſet a layſyng compaſſe or a needle, touched with the Lode ſtone, and couered ouer with a glaſſe. And on the higheſt edges of this baſe, the two braunches of the Paſſel ſhalbe made faſt, and this baſe, with the Paſſel, the halfe circle, and the circle, ſhalbe all one peece, whiche ſhalbe called the ſeate or frame of the inſtrument. The Horizontal circle in the endes of one halfe circle, muſt haue two holes, in the which may enter the Axis that are made in the endes of the lyne of Eaſt and Weſt.

The Foote or Baſe of the inſtrument.

Alſo you muſt take good heede when you ſother or make faſt the Paſſel in the baſe, that the North and South of the plate or Horizon, come with the North and South of the needle that is beneath, hauyng euer reſpect howe muche the needle doth vary from the Meridian, by Northeaſtyng or Northweſtyng. In the poynt of the two halfe circles vpon the Paſſel, muſt be a poynt (called the index or ſhewer) which ſhal ſhewe in the halfe circle, ſothered in the plate on the neather part, the degrees that the pole is rayſed aboue the Horizon.

The Index or ſhewer.

For the perfection of this inſtrument, it ſhalbe conuenient to ſet the Horizon very playne and equal at the tyme of the operation or practiſing with the inſtrument, and this may be done in two maners. Whereof the one is, hangyng by a fine threede, at the canter of the plate, a plomet made ſomewhat poynted at the neather ende: ſo that the Horizon ſtandyng playne & leuel, the poynt of the plomet may fal vpon the poynt of the index, and this maner is good for the lande. But for the Sea, you ſhall ſother the Horizon two Axes, lytle ſtubbes or endes commyng foorth. Theſe ſhalbe put in the two oppoſite holes of a circle of mettal made ſomwhat ſtrong, and this circle muſt haue other two ſtubbes lykewyſe commyng foorth, and equally diſtant from the two holes. Theſe muſte be ſothered or nayled in two

The placyng of the Horizon.

For the lande.

For the Sea.

holes

holes of another circle in like maner, and the other circle with other two stubbes, inclosed in a boxe. If then ỳ boxe stand euen and leuel, the poyse or wayght shal cause the Horizon to stande leuel, although the shyp swap or roule from side to side. The vse of this instrument is in this maner.

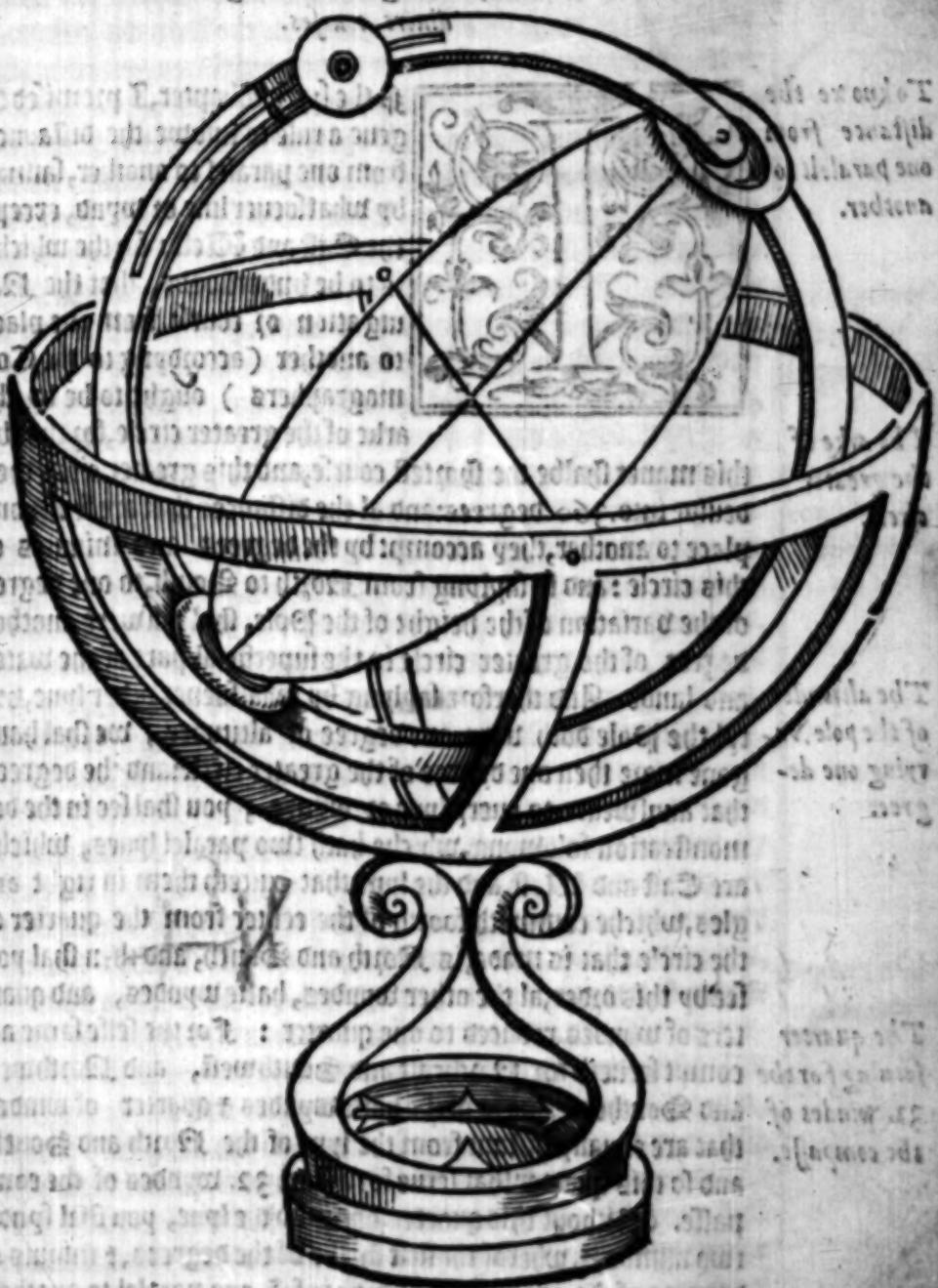
The vse of the instrument.

When you desire to knowe the paralel in whiche you are, and the houre that is, put the lyne that trauerseth the grayne, in the degree of the signe in the whiche the Sun is (which you shal knowe by the table of the place of the Sunne, in the seconde Chapter of the seconde parte) and set the North and the South of the plate, with the North and South of the needle. Then turne the moueable Meridian agaynst the Sunne, the foote of the instrument standyng faste, and rayse it, or put it downe in the plate, vntyll the beame of the Sunne enter in at the hole of the grayne, and fal in the center of the plate, and standing so, behold the index, and how many degrees it sheweth from the Meridian, so muche is the altitude of the pole. Then looke where the moueabe Meridian sheweth in the rundel of the houres: and there shal you see the houre that is.

The altitude of the Pole.

Here

Here foloweth the demonſtration.



The xii. Chapter, of the leagues that are runne for a degree, according vnto diuers courses.

To knowe the distance from one paralell to another.

IN the lyxth Chapter, I promised to geue a rule to knowe the distaunce from one paralel to another, sailing by whatsoeuer line or wynd, except the East and West: for the whiche is to be vnderstoode, that the Nauigation or course from one place to another (accordyng to the Cosmographers) ought to be by the arke of the greater circle, for that by this maner shalbe the shortest course, and this greater circle they deuide into 360. degrees: and al the distances that are from one place to another, they accompt by the degrees and minutes of this circle: and so sayling from North to South, to one degree of the variation of the height of the Pole, shal answere another degree of the greater circle in the superficial part of the water and lande. And therfore sayling by whatsoeuer other lyne, vntyl the Pole doth vary one degree of altitudes, we shal haue gone more then one degree of the greater circle: and the degrees that answeare to euery lyne or wynde, you shal see in the demonstration folowyng, whiche hath two paralel lynes, whiche are East and West, and the lyne that cutteth them in right angles, whiche commeth foorth of the center from the quarter of the circle that is made, is North and South, and then shal you see by this order, al the other wyndes, halfe wyndes, and quarters of wyndes, reduced to one quarter: For the selfe same accompt serueth for Northeast and Southwest, and Northwest and Southeast, and so of the halfe wyndes & quarters of windes that are equally distant from the lyne of the North and South: and so this quarter shal serue for al the 32. wyndes of the compasse. Without this quarter, harde by the lyne, you shal fynde two numbers, whereof the first shalbe of the degrees, & minuts of degrees of the great circle, which is frō one paralel to another.

The arke of the greater circle.

The altitude of the pole varying one degree.

The quarter serueth for the 32. windes of the compasse.

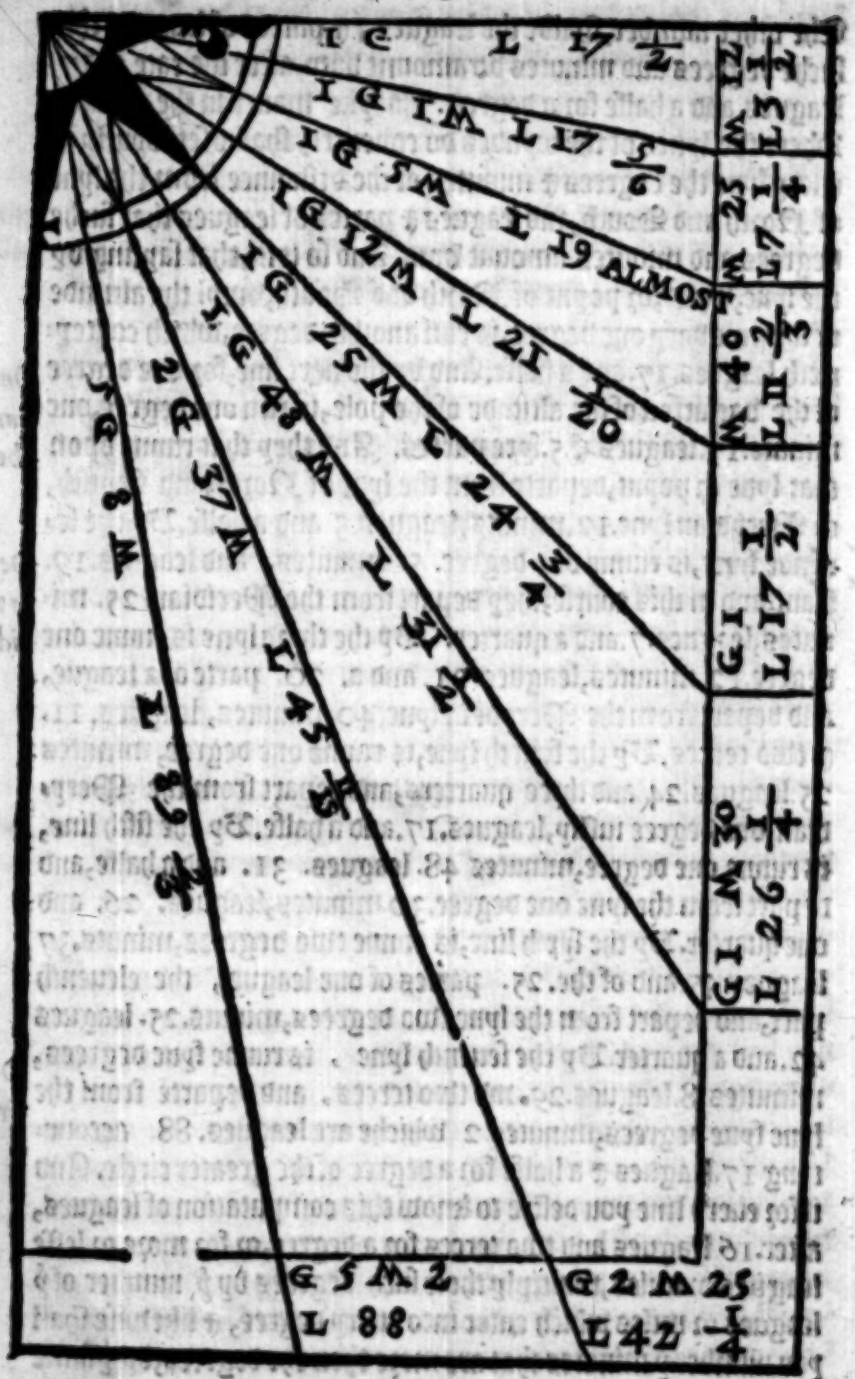
The

The other number, shalbe the leagues, & partes of leagues that suche degrees and minutes do amount vnto, after the rate of 17. leagues and a halfe for a degree. In lyke maner in the paralel, where the lynes of the wyndes do concurre, shalbe set ioyntly to euery lyne the degrees & minutes of the distaunce from the lyne of North and South, and leagues & partes of leagues that suche degrees and minutes amount vnto. And so it is, that sayling by the lyne, wynd, or poynt of North and South, oneli the altitude of the pole vary one degree, is run another degree, which conteyneth leagues. 17. and a halfe. And by the next line, for one degree of the variation of the altitude of the pole, is run one degree, one minute. 17. leagues. & 5. fyre partes. And they that runne vpon that lyne or poynt, departe from the lyne of North, and South, or Merydian lyne. 12. minutes, leagues. 3. and a halfe. By the seconde lyne, is runne one degree. 5. minutes, and leagues. 19. scant, and in this sourse, they depart from the Meridian. 25. minutes, leagues. 7. and a quarter. By the third lyne is runne one degree. 12. minutes, leagues. 21. and a. 20. parte of a league, and depart from the Merydian lyne. 40. minutes, leagues. 11. & two terces. By the fourth lyne, is runne one degree, minutes 25. leagues. 24. and three quarters, and depart from the Merydian, one degree iustly, leagues. 17. and a halfe. By the fifth line, is runne one degree, minutes 48. leagues. 31. and a halfe, and depart from the lyne one degree. 30. minutes, leagues. 26. and one quarter. By the syxth line, is runne two degrees, minuts. 37 leagues. 45. and of the. 25. partes of one league, the eleuenth part, and depart from the lyne two degrees, minuts. 25. leagues 42. and a quarter. By the seuenth lyne, is runne fyue degrees, minutes. 8. leagues. 29. and two terces, and departe from the lyne fyue degrees, minutes. 2. whiche are leagues. 88. accounting 17. leagues & a halfe for a degree of the greater circle. And thus for euery line you desire to know this computation of leagues, after. 16. leagues and two terces for a degree, or for more or lesse leagues or miles, multiply those such degrees by ỳ number of ỳ leagues or miles which enter into euery degree, & likewise shall you number ỳ minutes that are more then the degrees, by ỳ same number

One degree of variation of the pole.

Departyng from the Meridian lyne.

Degrees of the greater circle.


I G L 17 1/2
I G 1 M L 17 5/6
I G 5 M L 19 ALMOST
I G 12 M L 21 1/20
I G 25 M L 24 3/4
I G 48 M L 31 1/2
2 G 37 M L 45 1/15
5 G 8 M L 89 3/4
G 5 M 2 L 88
G 2 M 25 L 42 1/4
G I M 30 L 26 1/4
G I L 17 1/2
M 40 L 11 2/3
M 25 L 7 1/4
M 12 L 3 1/2

number of the leagues that enter in euery degree, deuiding them by sixtie, and that that shal come of the diuision, you shal ioyne with the multiplication of the degrees, and that shal amount thereof, shalbe the leagues, and partes of leagues, that was in those such degrees.

The .xiii. Chapter, howe to set or make a pricke in the Carde of Nauigation.

THe Mariners cal the prickyng of a poynt in the Carde, to set and appoynt in it, in what poynt or part of the sea the shyp is in Nauigation. For the performing wherof, it shalbe requisite that the Pilot knowe from what degree, or how many degrees of the altitude of the pole he departed, & with what wynde he sayleth. And when he desyreth to knowe where he is, let hym know the altitude of the pole, by some of the afore-sayde rules. And yf takyng the altitude, he fynde hym selfe in the same degrees where he was when he departed, his Nauigation hath ben from the East to the West, and what he hath gone can not be knowen but by the iudgement of a wyse and expert man, accordyng to the swyftnesse or goodnes of his shyp, with consideration of the more or lesse tyme he hath had, as we haue sayde before in the syxth Chapter. But yf he fynde him selfe in more or lesse degrees, let hym take two payre of compasses, and put the foote of one, in ỹ poynt or place where his shyp was when he departed, and the other in the lyne or wind by the which he sayleth, and lykewyse let hym set the one poynt of the other compasse in the graduation of the Card, in that number of degrees that he fyndeth the altitude of the pole, and the other poynt of the same compasse in the next lyne of East & West: and so with both the compasses, one in the one hande, and the other in the other hand, let hym goe ioynyng them togeather, takyng good heede, that the poynt of the compasse do not swarue from the winde whereby he hath sayled, neyther the poynt of the other compasse from the lyne of East and West, where he set it.

To knowe in what part or poynt the shyp is.

The altitude of the pole.

To fynde the distance by the Carde.

And

And folowyng thole two compalles by theſe two lynes, vntyll the poyntes of the two compalles ioyne (that is to meane, the poynte that was ſet in the place from whence he departed, and the other that was ſet in ỹ degrees that were found) then where theſe two poyntes do ioyne, is the poynt where the ſhyppe is. But (as we haue ſayde in the lyxt Chapter) they muſt haue great reſpecte to the wyndes and ſeas, and other thynges whiche experience ſheweth them, to knowe yf they haue gone directly by that lyne, or if they haue fallen from it, and to what part: the whiche I remitte to the iudgement of men of good experience. From thence forwarde, they ſhall returne to keepe the ſame account, as when they departed from the hauen, eſpecially when they change their courſe.

Aduertiſmentes to the Pilotes.

¶ The. xiiii. Chapter, of the making and vſe of an Inſtrument general, to knowe the houres and quantities of the day, and at what ſyde the Sunne ryſeth and falleth.

TAke a roumde plate with a ryng or a handle aboue, as in the Aſtrolabie, drawing a line from the ring downwarde paſſyng through the center, and another line that may cut it in ryght angles through the center: And this laſt lyne ſhalbe called the Horizon. Then ſhal you geue a circle vpon the center, leauing ſo much ſpace betweene it and the edge of the plate, that therein may be wrytten the numbers of the degrees: then alſo make another circle ſomwhat more within, leauing like wyſe a ſpace where the graduations may be deuyded. This done, deuide one of the high eſt quadrantes toward the left hand into 90. partes, whiche ſhalbe called the degrees of latitude, begynnyng the number of them from the ryng, & endyng the ſame in the Horizon. Then make another rundel ſomwhat leſſe then this, in ſuch maner that the degrees and numbers of the greater, remayne vncouered.

And

And deuide this lesse, by two diameters into foure equal peces. And at the one end of the one Diameter, leaue a poynt comming foorth of the lesse rundle, cut directly with the same Diameter by the one part, and this shalbe called the inder or shewer. In this rundel you shall make a circle halfe a fynger lesse then the rundel. Then with a compasse take. 23 degrees and a halfe from the Diameter, whiche signifieth the Equinoctiall: and whereas end the 23. degrees and a halfe, for euery part make a ryght lyne from one poynt to another, so that this be a lyne of 47. degrees, and as muche more at the other ende of the sayde Equinoctiall. Upon euery one of these ryght lynes, you shall make a halfe circle, and deuide euery of them into fyue equall partes, whiche may aunsweare to fiue signes, and euery signe into three partes, which may aunsweare to the tenthes or tenth partes of degrees: and yf the instrument be great, you shal deuide euery signe into fiue or moe partes, so that you may make it perfect & precise. This doone, from the poyntes or pyckes of the one halfe circle, to the poyntes of the other, draw certaine lynes whiche shalbe equidistaunt to the Equinoctiall. In the endes of these lynes, betweene the lesse circle, and the edge of the rundel, draw also certayne lynes, whiche may reache vnto the begynnynges and endes of the signes: and in the toppe of the endes, or ouer the endes of these lynes, make an Arke, so farre distaunt from the lesse circle, as is the thicknesse of the edge of a peece of foure ryals of plate: And in the space that is left, graduate the signes from tenne to tenne, or as the diuision shalbe. The space that remaineth from thence to the edge of the rundel, you shal deuide by the halfe, and in it shalbe made twelue spaces, where you shal set the signes with their names or characters orderly, so that Aries be next vnto the Equinoctial, then Taurus towarde the part of the Inder, then Gemini: and turnyng towarde the Equinoctial, Cancer, Leo, Virgo. Likewyse on the other parte of the Equinoctiall, Libra, Scorpio, Sagittarius. And turnyng to the Equinoctial, Capricornus, Aquarius, Pisces. And thus hauyng signed the Zodiache, you shal also signe or marke the houres in maner as followeth.

The placing of the twelue signes in the instrument.

The Zodiache

Deuide the lesse circle of this rundel into foure equal partes, so that euery quarter may haue sixe partes. Reduce this diuision to the Diameter, puttyng the ruler vpon the poyntes, equally distant from the Horizon. And where it toucheth the Equinoctial, make prickes or poyntes, so that the Equinoctial remaine deuided into twelue partes. Then vpon one of the Tropykes geue a circle, whiche may haue the same Tropike for his Diameter. Deuide this circle into .24. equal partes, & reduce these diuisiõs to the Tropike, as is done in the Equinoctial, & from one Tropike to another: then the Equinoctial and the Tropikes being thus deuided with these prickes or poyntes, you shal passe with a payre of compasses by euery poynt equally ordered from the Horizon, to the one and the other part: and these shalbe called houres, wryting in the endes of them theyr numbers, beginning the one part in one, and ending it in twelue. On the other part, begin the one in thopposite part, and ende in twelue. This done, these rundels shalbe brought to their perfection. Moreouer, you shal make a triangle, with a right angle, hauing two equal sides that may make the right angle: Euery of these sides must be as long as is the Semidiameter of the greatest rundel: also, vpon and about the right angle, you shal make a litle circle, whiche shal haue the same angle for his center, & on the one side of this triangle, set two raysed plates, as in the Astrolabie: on the contrary side of these raysed plates, must be a hole, so farre distaunt from the center or angle, as is the Semidiameter of the circle of the lesse rundel. In this hole you must put a threede, hanging therat a litle waight or plommet, onely sufficient to holde the threed strayght, so that it cause nothyng of the rundels to turne, or the instrument to decline. Furthermore, in a circle as bygge as the lesse of the lesse rundel, you shal deuide into .32. parts the eyght wyndes, and halfe wyndes, and quarters of wyndes. And beyng thus reduced to their Diameter (as is doone in the Equinoctial) you shal translate them in the sides of the triangle, in the which by the center of his litle circle, and by the center of the rundels, al the three peeces must be made fast with an axes or a nayle, so that they may be turned about close and very faste. Then put a ryng in the handle of the instrument, wherby it may hang,

Diuision of the Equinoctial & Tropikes.

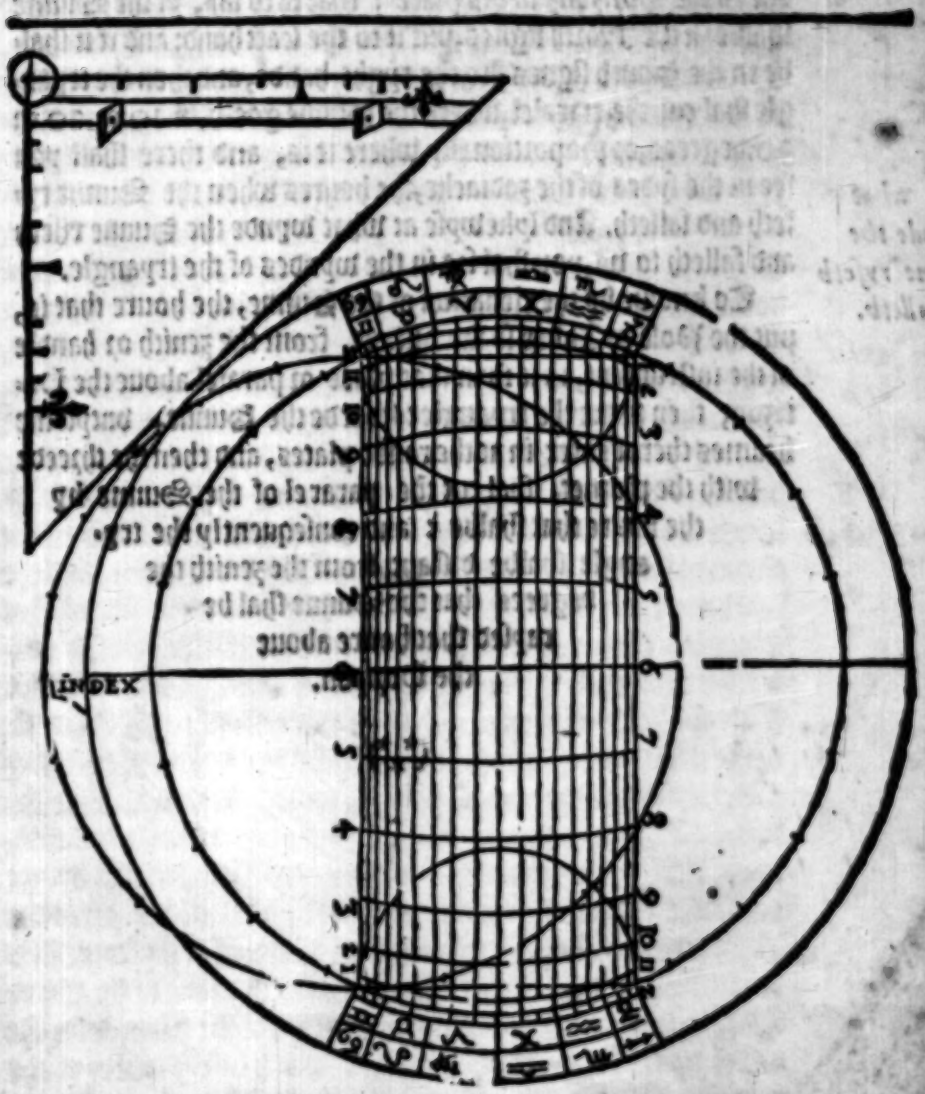
The houres with theyr numbers.

The triangle.

Diuision of the wyndes.

hong, as in the Astrolabie: and so shal the instrument be finished and brought to perfection.

This is the trace or draught of the instrument.

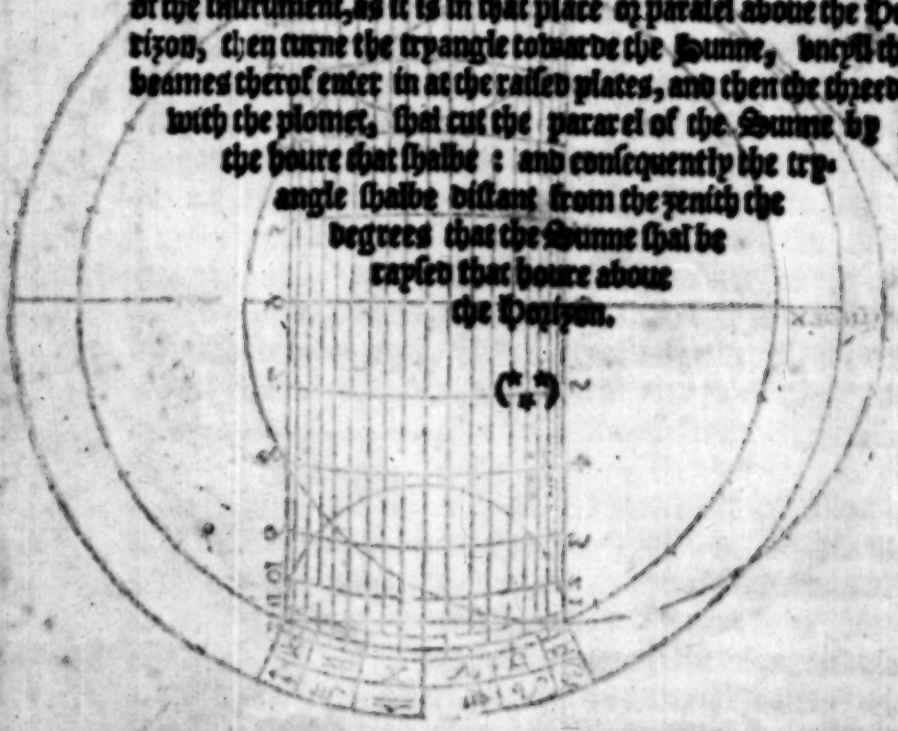


To knowe at what houre the Sunne ryseth or falleth.

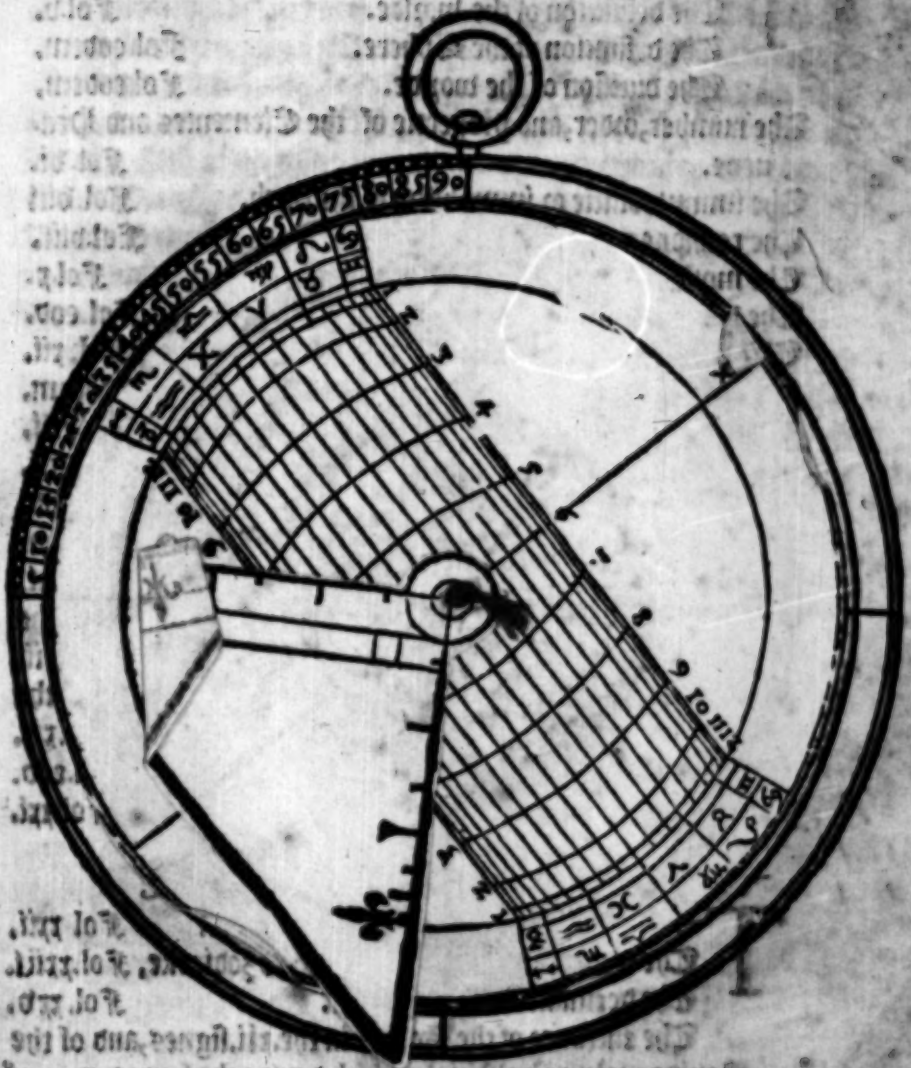
To knowe at what houre the Sunne ryseth and falleth (by the instrument folowyng) you shal put the Pole of the lesse rundell (which is the index) to the leaft hand in the greatest rundel, in so many degrees aboue the Horizon, in howe many degrees the Pole is raised in that land or place. Then put the triangle (whiche is the Horizon) in his place: that is to say, yf the Sunne shalbe in the North signes, put it to the leaft hand: and if it shalbe in the South signes, to the ryght hande, and then the tryangle shal cut the paralel where the Sunne goeth, in. 10. or. 20. or 30. degrees, or proportionally where it is, and there shall you see in the sydes of the zodiacke, the houres when the Sunne ryseth and falleth. And lykewyse at what wynde the Sunne riseth and falleth to vs, you shal see in the wyndes of the tryangle.

At what wynde the Sunne ryseth or falleth.

To knowe by the elevation of the Sunne, the houre that is, put the Pole or Index so far distant from the zenith or handle of the instrument, as it is in that place or paralel aboue the Horizon, then turne the tryangle towarde the Sunne, vntyll the beames therof enter in at the raised plates, and then the threede with the plomet, shal cut the paralel of the Sunne by the houre that shalbe: and consequently the tryangle shalbe distant from the zenith the degrees that the Sunne shal be rayled that houre aboue the Horizon.



This is the Demonstration.



FINIS.

To knowe what be the

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CVM PRIVILEGIO.